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ABSTRACT

The papers in this volume are directed toward the problems of delineating and developing programmatic, directed, or targeted research and development. Because the authors represent a variety of research and development contexts both in and outside the educational system, the report is broadly representative of current thinking on programmatic research and development. The papers include: (1) "Programmatic Change" by Daniel L. Stufflebeam, (2) "Some Conceptions of Programmatic Research and Development" by Hendrick D. Gideonse, (3) "The Convergence Technique: An Alternative Strategy for Programmatic Research and Development" by Louis M. Carrese, (4) "A Model for Educational Development" by John K. Hemphill, (5) "Managed Research in Vocational Education" by Jerome Moss, Jr., (6) "Programmatic Research and Development at the Center for Vocational and Technical Education" by Edward J. Morrison, and (7) "The Work Adjustment Project" by Rene V. Dawis. A final section provides the editors' comments on the ideas presented in the papers. (BH)

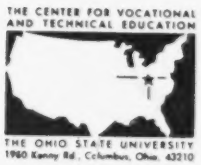
ED 069844

PROGRAMMATIC RESEARCH and DEVELOPMENT in EDUCATION:

POSITIONS
PROBLEMS
PROPOSITIONS

Frank C. Pratzner and Jerry P. Walker

RESEARCH AND DEVELOPMENT SERIES 70



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The Center's mission is to strengthen the capacity of state educational systems to provide effective occupational education programs consistent with individual needs and manpower requirements by:

- Conducting research and development to fill voids in existing knowledge and to develop methods for applying knowledge.
- Programmatic focus on state leadership development, vocational teacher education, curriculum, vocational choice and adjustment.
- Stimulating and strengthening the capacity of other agencies and institutions to create durable solutions to significant problems.
- Providing a national information storage, retrieval and dissemination system for vocational and technical education through the affiliated ERIC Clearinghouse.

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Research and Development Series 70

Programmatic Research And Development In Education: Positions, Problems, Propositions

Frank C. Pratzner
and
Jerry P. Walker
Editors

The Center for Vocational and Technical Education
The Ohio State University
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FOREWORD

> Although action is typical of the American style, thought and planning are not; it is considered heresy to state that some problems are not immediately or easily solvable, that it might take. . .perhaps a generation for real improvement to occur. A sense of historical time is absent from American thought, and a desire for "instant" reform or "instant" solution is deeply ingrained in the American temper.
>
> Daniel Bell
> Chairman, Committee on the Year 2000
> American Academy of Arts and Sciences[1]

Ours appears to be a time of synthesis and redirection in educational research and development. It is a time characterized by the attempt to "put together" the extant bits and pieces of potential problem solutions and to develop improved planning methods and procedures to assure that, in the future, the work of large numbers of educational researchers and developers is an integral part of a larger plan to generate the ideas and products in significant numbers and quality to make a practical and visible difference in American schools.

Within the last six years, a variety of significant events have contributed to a growing concern among educational researchers and developers that the bulk of their work be directed toward the immediate reduction of pressing problems in American education. Among the events which have helped set the tone of the current concern were passage of the Elementary and Secondary Education Act in 1965 and the Vocational Education Amendments of 1968, establishment of the network of regional educational laboratories in 1966 and the Research Coordinating Units in vocational education in 1965, reorganization of the U.S. Office of Education and the formation of the National Center for Educational Research and Development (NCERD) in 1970 to replace the Bureau of Research, and the plans currently being formulated for the creation of a National Institute of Education as proposed by President Nixon in his White House message on education presented in March, 1970.

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[1] Daniel Bell. "Toward the Year 2000: Work in Progress - The Trajectory of an Idea," *Daedalus*, Vol. 29, Summer 1967, p. 648.

While not as easily identifiable as discrete events, the general disillusionment of the U.S. Congress with educational research and development, increasing dissatisfaction of large segments of the public with education which is often viewed as irrelevant and inefficient for their needs, and the relatively long lag-time in education for new ideas and products to become widely accepted and used have each contributed to the growing awareness of the need for the systematic planning of educational research and development.

Educational researchers and developers faced with the prospect of planning and conducting "programmatic," "directed," or "targeted" research and development are, at the same time, challenged with the obvious questions of – what is it and how does one go about doing it. The papers presented herein are attempts to formulate some initial reactions and answers to these questions.

All but two of the papers and the Summary and Conclusions section were written originally for a meeting of the Research Section of the New and Related Services Division, the American Vocational Association. They were presented at the 64th annual convention of the AVA in December, 1970, in New Orleans.

The papers by Stufflebeam and Gideonse present two perspectives on the nature of programmatic research and development. Stufflebeam approaches the problem from the point of view of the purposes of programmatic research and development describing specific change strategies appropriate for adoption, development, diffusion, and research. He then discusses a conceptual framework or model for classifying and understanding the types of decisions involved in programmatic change.

Gideonse also defines programmatic research and development in terms of the objectives or goals toward which it is aimed. Three types of goals are discussed as giving rise to different kinds of programmatic research and development each having different management requirements, manpower needs, information flow requirements, and implications for the relationships between the research and development community and the larger political and institutional environment.

Two papers are specifically addressed to the problems of doing programmatic research and development. The Carrese paper, describing the Convergence Technique developed and used for cancer and other medical research programs, emphasizes the application and strategies of the technique for planning research activities. Hemphill, on the other hand, discusses significant differences between research and development and describes why a different model, sets of strategies, and management considerations are appropriate for planning systematic, educational development.

The Moss paper originally was presented at the AVA convention in New Orleans as the Presidential Address to the membership of the American Vocational Education Research Association. It has been included here because it describes additional and significant implications of programmatic research and

development and suggests several practical steps which can be taken now to move toward programmatic research and development in education.

The papers by Morrison and Dawis describe independent and successful examples of relatively long-term, programmatic research and development undertakings. Relevant characteristics, planning procedures, and management aspects of each of the programs are described to provide the reader with visible and practical examples of ongoing, programmatic research and development.

The editors have used the Summary and Conclusions section to highlight the perceived significance, commonalities, and evolving characteristics of programmatic research and development in education. Their comments and observations are intended primarily to provide continuity to the report and to help knit together the several threads of thought reflected in the separate papers.

The authors represent a variety of research and development contexts: a regional educational laboratory, the U.S. Office of Education, a university-based evaluation center, a research and development organization outside of education (National Cancer Institute), a national educational research and development center, a Research Coordinating Unit, and a university-based research and development project. Because of these differences in perspectives, the report is broadly representative of the current thinking of the educational research and development community regarding the nature and conduct of programmatic research and development, and it should be of interest and value to other research and development specialists in similar settings, those in private research and development organizations, those charged with research and development responsibilities in local schools and school districts, to individual researchers and developers, and to graduate students currently preparing for careers in educational research and development.

We would like to thank each of the authors for their contributions to this report.

Columbus, Ohio
December 28, 1971

F.C.P.
J.P.W.

PREFACE

The Center, being devoted to the improvement of vocational and technical education, has worked for some years to evolve practical means for assuring that its efforts result in products which have significant effects on educational practice. Other agencies and individuals also have wrestled in other contexts with the problems of programming research and development activities to meet significant objectives. This work has required a kind of thinking about a host of theoretical and practical problems which is not common in education. Especially, it has required careful selection of goals and specific objectives as a first step, and then the development of an organized, usually complex, sequence of activities to ensure a high probability that objectives are achieved efficiently with the allocated time and resources.

This volume brings together several reports from these efforts, presenting important models of the process of programmatic research and development, methods and techniques for managing and doing programmatic work, examples of programmatic work in particular settings and, throughout, a view of the problems, value issues, strategic questions, controversies, and implications which must be confronted. It is hoped that this collection will prove useful not only as an introduction to the topic, but also as an effective stimulus to those who can join the effort to improve our methods for achieving important educational outcomes.

Grateful acknowledgement is due each author who contributed to this volume. Most chapters represent substantial contributions of new material. All were prepared by busy people who, nonetheless, found time to serve us all. Special recognition is due Drs. Pratzner and Walker of The Center who first recognized the need for such a volume, organized the necessary effort, contributed integrating and summarizing material, and edited the entire volume.

Robert E. Taylor
Director
The Center for Vocational and
Technical Education

PROGRAMMATIC RESEARCH AND DEVELOPMENT IN EDUCATION: POSITIONS, PROBLEMS, PROPOSITIONS

I
PROGRAMMATIC CHANGE

Daniel L. Stufflebeam [2]

INTRODUCTION

My responsibility in this symposium is to present an overview of the processes which are related to and necessary for the programmatic improvement of education.

At the outset I wish to define programmatic change as that change which occurs according to a schedule or system under which action is taken toward a desired goal.[3] Given this definition a discussion of programmatic change should encompass all of the processes which determine goals and which are involved in the designing, implementing, and recycling of procedure systems required to achieve the goals.

Two types of processes seem appropriate for consideration. The first type includes decision-making and evaluation, which are seen to be general leadership activities that govern the total change process. The second type of process includes adoption, development, diffusion, and research which are conceived to be specific change processes that are employed selectively and in various configurations to achieve a variety of desired ends. The task I have set for myself in this paper is to define these two sets of processes and show how they relate to each other within the larger framework of programmatic change.

Accordingly, the body of the paper is organized into three major parts. The first part defines the general leadership processes of decision-making and evaluation. The second defines the specific processes of adoption, development, diffusion, and research. The concluding part provides models of the relationships among the conceptualized general leadership processes and specific change processes. Without further introduction let us consider the leadership processes of decision-making and evaluation.

---

[2] Director, Evaluation Center, The Ohio State University, Columbus, Ohio.

[3] This definition of programmatic change is in accord with a particular dictionary definition of program, to wit, a program is a schedule or system under which action may be taken toward a desired goal.

PART I

GENERAL LEADERSHIP PROCESSES

Decision-making and evaluation are general and pervasive processes which are omnipresent in programs of change. Educational leaders must make crucial decisions (within a general policy framework) concerning both ends and means. To make these decisions, the leaders need to depend heavily on evaluation which reveals and assesses alternative ends and means that might be chosen. Consequently, in any program of change, decision-making and evaluation largely determine which of the specific change processes should be employed and how those processes should be sequenced and executed.

Given this brief overview of the decision-making and evaluation processes, let us now consider each in further detail.

Decision-Making

Decision-making is formally defined in this paper as the PROCESS OF CHOOSING FROM AMONG TWO OR MORE AVAILABLE OPTIONS IN RESPONSE TO SOME SITUATION REQUIRING ALTERED ACTION.

The decision-making process conceived of in this way may vary as a function of two important factors. First, the decision-maker must make his decision in terms of the situation requiring altered action, i.e., a particular change setting. Secondly, in making choices among options in the process of effecting any complex change, he must make many different types of decisions. These factors are considered in the following discussion of decision-making.

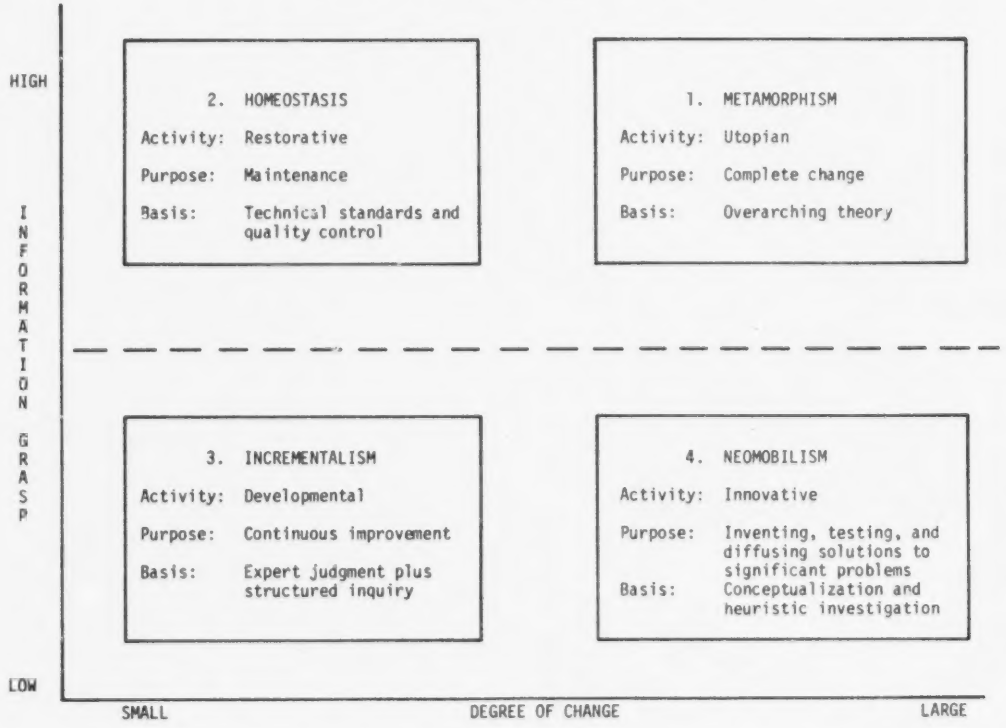
Change Settings

The first decision-making concept to be considered, then, concerns change settings. In this connection the formulations in this paper are based heavily on Braybrooke and Lindblom's work in the area of public policy, although I have not conformed exactly to their proposals (Braybrooke and Lindblom, 1963).

Figure 1 summarizes a conceptualization of four generally different change settings. Each of these settings may be considered as a special case of programmatic change since each denotes goal-directed change activity. The four settings have been differentiated through the intersection of two continua: "small" versus "large" educational change, and "high" versus "low" information grasp to support change.

The utility of these two continua arises directly as a consequence of two factors. The first is the need to determine the nature and extensiveness of the evaluation which will be required to support the desired change. The second is the need to determine the particular model of change processes to be employed. Clearly, the extensiveness and rigor of evaluation to be pursued should be a

FIGURE 1:
PROGRAMMATIC CHANGE SETTINGS



function both of the extent and importance of change to be effected and the amount of understanding which already exists to effect the change. Likewise, these two continua also have much to do with the determination of which specific change processes (i.e., adoption, development, diffusion, and research) should be pursued according to what network of procedures.

Combining the continua of amount of change and degree of information grasp produces the four different change settings of Figure 1. These are: (1) decisions to effect large changes supported by a high level of relevant information grasp (the upper right cell of Figure 1: Metamorphism); (2) decisions to effect small changes supported by a high level of relevant information grasp (the upper left cell of Figure 1: Homeostasis); 3) decisions to effect small changes supported by a low level of relevant information grasp (the lower left cell of Figure 1: Incrementalism); and (4) decisions to effect large changes supported by a low level of relevant information grasp (the lower right cell of Figure 1: Neomobilism). Let us briefly consider each of these change settings.

Metamorphic Change: denotes utopian activity intended to produce complete changes in an educational system which are based upon full knowledge of how to effect the desired changes. The probability of this kind of change in any educational institution is indeed slim. Therefore, in the interest of time, this setting will not be dealt with further in this paper.

Homeostatic Change: denotes restorative activity aimed at maintaining the normal balance in an educational system and guided by technical standards and a routine, cyclical data collection system.

Of the four types being considered, settings of the homeostatic type are the most prevalent in education. Staff assignments, scheduling of students, and establishment of bus routes illustrate this decision-making setting. Most educational agencies have adequate quality control evaluation programs to service their homeostatic decision needs. Further, the changes effected by these decisions are small and remedial. All in all, no major breakthroughs in programmatic change theory are needed to service such minor adjustments which are already based on adequate supplies of information. We shall therefore not consider this setting in further detail.

Incremental Change: denotes developmental activity having as its purpose continuous improvement of a program. Such activity usually is supported by expert judgment and structured inquiry into the efficacy of the present program and the recommended changes. Decision-making in this quadrant differs from homeostatic decision-making in two respects. First, incremental decisions are intended to shift the program to a new normal balance based upon small, serial improvements, while homeostatic decisions are intended to correct the program and change it back to its normal balance. Second, while homeostatic decisions are supported by technical standards and a continuing supply of routinely collected information, evaluations for incremental change are usually ad hoc and supported by little extant knowledge. Special studies, the employment of expert

consultants, and the formation of special committees characterize most efforts to introduce incremental change.

Incremental change is very prevalent in education. Many so-called educational innovations are of the incremental type. They are attempts to make improvements in the present program without risking a major failure or major expense. Though there is little information to support such changes, the adjustments are sufficiently small that corrections can be made as problems are detected. As might be expected, such changes are based on trial and error and are iterative and serial in nature. Also, such changes often require allocations of special resources. Title I of the Elementary and Secondary Education Act has fostered much incremental change.

Neomobilistic[4] Change: denotes innovative activity for inventing, testing, and diffusing new solutions to significant problems. Such change is supported by little theory or extant knowledge. Yet the change is often large, often because of great opportunities such as those being produced by the knowledge explosion or because of critical conditions such as riots in inner cities. Programmatic change strategies to support neomobilistic efforts usually are ad hoc complex types of programs. Often these efforts are exploratory and heuristic at the beginning of a change effort and then become increasingly rigorous as the change progresses.

Neomobilistic decision-making is becoming more prevalent in education. Critics of education who advocate higher rates of change, the explosive conditions in our cities, and the emergence of specialized agencies to effect programmatic change are all factors which have served to motivate this kind of change. Title III projects, educational development laboratories, educational policy research centers, and the proposed National Institute for Education are all illustrations of expenditures of risk capital to stimulate educators to create, to try out, and to effect new solutions to significant problems. Let us now turn to the concept of decision type.

Types of Decisions

Knowledge of the four change settings just discussed is a necessary but not sufficient condition for an understanding of decision-making in programmatic change. Also needed is a typology or taxonomy of decisions whose categories are exhaustive of all possible educational decisions and at the same time mutually exclusive. Under those circumstances generalizable designs for programmatic change which fits all decision types within similar categories become feasible.

Figure 2 presents the conceptual base from which a proposed typology of decisions has been generated. According to this chart decisions should be classified as a function of their pertinence to ends or means and to intentions or actualities. Thus, all educational decisions may be exhaustively and unambigu-

[4] A term contrived to convey the idea of change or movement toward the new.

FIGURE 2:
TYPES OF DECISIONS

	INTENDED	ACTUAL
ENDS	PLANNING DECISIONS to determine objectives	RECYCLING DECISIONS to judge and react to attainments
MEANS	STRUCTURING DECISIONS to design procedures	IMPLEMENTING DECISIONS to utilize, control and refine procedures

ously classified as pertaining to (1) intended ends (goals), (2) intended means (procedural designs), (3) actual means (procedures in use), or (4) actual ends (attainments). This schema has allowed the identification of four types of educational decisions: (1) planning decisions to determine objectives, (2) structuring decisions to design procedures, (3) implementing decisions to utilize, control, and refine procedures, and (4) recycling decisions to judge and react to attainments.

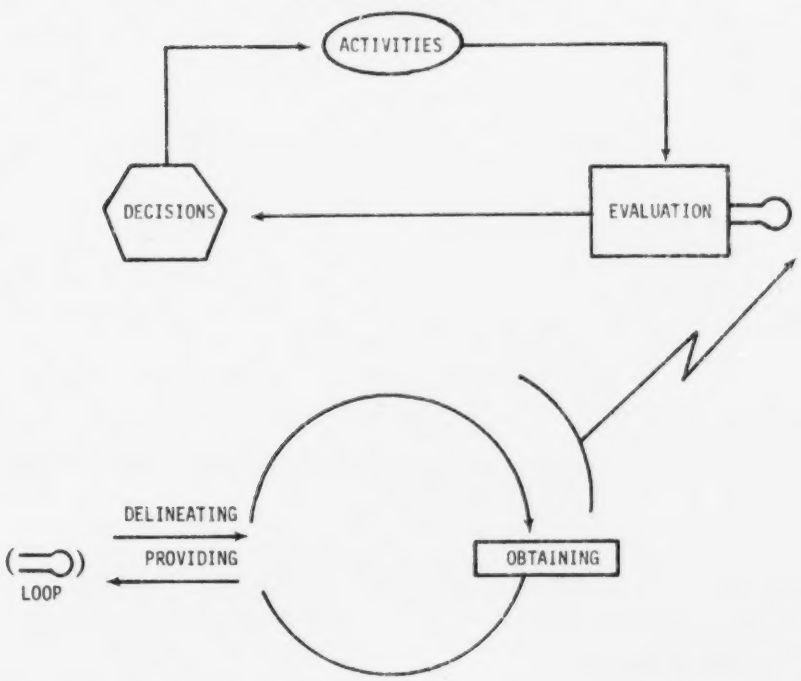
So far we have seen that decision-making has two major features. It can occur in four settings called metamorphic, homeostatic, incremental, and neomobilistic. And it can relate to four types of decisions called planning, structuring, implementing, and recycling. Next, we shall analyze the nature of the evaluation studies that are needed to service decision-making as it has been conceptualized in this paper.

Evaluation

The definition of evaluation employed in this paper was developed by the Phi Delta Kappa National Study Committee on Evaluation. According to that committee: EVALUATION IS THE PROCESS OF DELINEATING, OBTAINING, AND PROVIDING USEFUL INFORMATION FOR JUDGING DECISION ALTERNATIVES.

The general logic of this definition is shown in Figure 3. Program operations are evaluated in order to influence decisions, which influence program operations, which are in turn evaluated, ad infinitum. The loop to the right of the evaluation block in Figure 3 is included to remind one that the evaluation process includes three steps: delineating the information to be collected, obtaining the information, and providing the information. According to this paradigm any evaluation study involves these three steps.

FIGURE 3:
THE RELATION OF EVALUATION TO DECISION-MAKING



Corresponding to the four decision types identified in the previous section are four types of evaluation--context, input, process, and product. These are portrayed in Figure 4 in relation to the four types of decisions. Context evaluation serves planning decisions to determine objectives; input evaluation serves structuring decisions to determine project designs; process evaluation serves implementing decisions to control project operations; and product evaluation serves recycling decisions to judge and react to project attainments.

As a means of monitoring a system and, thereby, providing information on needed changes, context evaluation is mainly general and systematic. However, the other three types of evaluation are specific and ad hoc; they come into play only after a planning decision has been reached to effect some sort of system change. Specific evaluation designs for each of these three design types vary according to the setting for the change. Generally speaking, the greater the change and the lower the information grasp (decision-maker's knowledge of how to effect the change), the more formal, structured, and comprehensive is the evaluation required.

FIGURE 4:

TYPES OF DECISIONS AND EVALUATION

	INTENDED	ACTUAL
ENDS	PLANNING DECISIONS supported by CONTEXT EVALUATION	RECYCLING DECISIONS supported by PRODUCT EVALUATION
MEANS	STRUCTURING DECISIONS supported by INPUT EVALUATION	IMPLEMENTING DECISIONS supported by PROCESS EVALUATION

Context Evaluation

Context evaluation is the most basic kind of evaluation. Its purpose is to provide a rationale for determining objectives. Specifically, it defines the relevant environment, describes the desired and actual conditions pertaining to that environment, identifies unmet needs and unused opportunities, and diagnoses the problems that prevent needs from being met and opportunities from being used. The diagnosis of problems provides an essential basis for developing objectives whose achievement will result in program improvement.

The method of context evaluation begins with a conceptual analysis to identify and define the limits of the domain to be served as well as its major subparts. Next, empirical studies are performed to identify unmet needs and unused opportunities. Finally, context evaluation involves both empirical and conceptual analyses, as well as appeal to theory and authoritative opinion, to aid judgments regarding the basic problems which must be solved.

Decisions served by context evaluation include deciding upon the setting to be served, the general goals to be sought, and the specific objectives to be achieved. Such decisions usually appear in the introductory sections of proposals to funding agencies or in requests for proposals by funding agencies.

Input Evaluation

The purpose of input evaluation is to provide information for determining how to utilize resources to achieve project objectives. This is accomplished by identifying and assessing (1) relevant capabilities of the responsible agency, (2) strategies for achieving project objectives, and (3) designs for implementing a selected strategy. Ultimately, alternative designs are assessed in terms of their resource, time, and budget requirements; their potential procedural barriers; the consequences of not overcoming these barriers; the possibilities and costs of overcoming these barriers; relevance of the designs to project objectives; and overall potential of the design to meet project objectives. In order to structure specific designs for accomplishing project objectives, this information is essential.

Methods for input evaluation are lacking in education. The prevalent practices include committee deliberations, appeal to the professional literature, the employment of consultants, and pilot experimental projects. It also is to be noted that the methodology of input evaluation varies greatly, depending upon whether high or low information grasp is available to support the change. In a homeostatic setting where small change is needed and where much information is available to support it, little formal evaluation usually is required. However, when the change setting is either incremental or neomobilistic (innovative) this situation reverses, and extensive efforts are required to provide the information which is not available but needed if the projected projects are to be successful.

Essentially, input evaluation provides information for deciding whether outside assistance should be sought to achieve objectives, what strategy should be employed, e.g., the adoption of available solutions or the development of new ones, and what design or procedural plan should be employed for implementing the selected strategy.

Process Evaluation

Once a designed course of action has been approved and begun, process evaluation is needed to provide periodic feedback to persons responsible for implementing plans and procedures. Process evaluation has three main objectives--the first is to detect or predict defects in the procedural design or its implementation during the implementation stages, the second is to provide infor-

mation for programmed decisions, and the third is to maintain a record of the procedure as it occurs.

There are four essential features of process evaluation methodology. These are the provision for a full-time process evaluator, instruments for describing the process, regular feedback meetings between the process evaluator and project personnel, and frequent updating of the process evaluation design. This is especially true in incremental and neomobilistic settings. The project director and his staff simply do not have the needed combination of time, objectivity, and expertise to perform their own process evaluation; and their information requirements evolve throughout the life of their project. However, in homeostatic settings, the project director may be able to carry on his own process evaluation, since he already knows a great deal about how his design will operate in practice, and since his project likely will be a much shorter-range one than that performed in a neomobilistic setting.

In summary, process evaluation provides project decision-makers with information needed for anticipating and overcoming procedural difficulties, for making preprogrammed decisions, and for interpreting project outcomes.

Product Evaluation

The fourth type of evaluation is product evaluation. Its purpose is to measure and interpret attainments not only at the end of a project cycle, but as often as necessary during the project term.

The general method of product evaluation includes devising operational definitions of objectives, measuring criteria associated with the objectives of the activity, comparing these measurements with predetermined absolute or relative standards, and making rational interpretations of the outcomes using the recorded context, input, and process information.

In the change process, product evaluation provides information for deciding to continue, terminate, modify, or refocus a change activity, and for linking the activity to other phases of the change process. For example, a product evaluation of a program to develop after-school study for students from disadvantaged homes might show that the development objectives have been satisfactorily achieved and that the developed innovation is ready to be diffused to other schools which need such an innovation.

This completes the description of the four types of evaluation. Figure 5 summarizes their main features.

This concludes my basic descriptions of decision-making and evaluation. In summary:

> Decision-making may occur in four different programmatic change settings called metamorphic, homeostatic, incremental, and neomobilistic;

FIGURE 5:
FOUR TYPES OF EVALUATION

	CONTEXT EVALUATION	INPUT EVALUATION	PROCESS EVALUATION	PRODUCT EVALUATION
OBJECTIVE	To define the *operating context*, to identify and assess *needs* and *opportunities* in the context, and to diagnose *problems* underlying the *needs* and *opportunities*.	To identify and assess *system capabilities*, available input *strategies*, and designs for implementing the strategies.	To identify or predict, in process, *defects* in the procedural design or its implementation, to provide information for the preprogrammed decisions, and to maintain a record of *procedural events* and *activities*.	To relate *outcome information* to objectives and to context, input, and process information.
METHOD	By describing the context; by comparing actual and intended inputs and outputs; by comparing probable and possible system performance; and by analyzing possible causes of discrepancies between actualities and intentions.	By describing and analyzing available human and material resources, solution strategies, and procedural designs for relevance, feasibility and economy in the course of action to be taken.	By monitoring the activity's potential procedural barriers and remaining alert to unanticipated ones, by obtaining specified information for programmed decisions, and describing the actual process.	By defining operationally and measuring criteria associated with the objectives, by comparing these measurements with predetermined standards or comparative bases, and by interpreting the outcomes in terms of recorded context, input, and process information.
RELATION TO DECISION-MAKING IN THE CHANGE PROCESS	For deciding upon the *setting* to be served, the *goals* associated with meeting needs or using opportunities, and the *objectives* associated with solving problems, i.e., for *planning* needed changes.	For selecting *sources of support*, solution *strategies*, and procedural designs, i.e., for *structuring* change activities.	For *implementing and refining the program design and procedure*, i.e., for effecting process control.	For deciding to *continue, terminate, modify* or *refocus* a change activity, and for linking the activity to other major phases of the change process, i.e., for recycling change activities.

Four types of decisions called planning, structuring, implementing, and recycling are made in each change setting; and

Four types of evaluation called context, input, process, and product are needed respectively to service the four types of decisions.

Next, let us turn to the second major part of the paper in which the specific change processes of adoption, development, diffusion, and research are defined.

PART II
SPECIFIC CHANGE PROCESSES

Programmatic change activities vary as a function of the objectives to be achieved and the procedural designs required to achieve those objectives. Accordingly, Clark and Guba have identified and defined four different specific change processes (Clark and Guba, 1965). These are adoption, development, diffusion, and research.

Figure 6 summarizes the essential features of each of these processes. The processes which appear along the horizontal dimension of the chart are defined according to the terms that appear on the vertical dimension of the chart. These latter terms are formal definition, the goal of the process, the role (or purpose) that may be served through achieving the goal of the process, and the agencies which are most heavily engaged in each process.

Without further introduction each of the four specific change processes will now be described. They will be considered alphabetically, as there is no consistent sequence for their occurrence in programmatic change efforts.

Adoption

Adoption is defined as the PROCESS OF INSTITUTIONALIZING A NEW PROGRAM. The goal of this process is to convert an innovation into a noninnovation within the adopting agencies.

The subprocesses involved in adoption include the selection of an innovation for adoption, the building of acceptance and credibility for the innovation within the adopting institution, the training of system personnel to use the innovation, the trial and modification of the innovation, the formal installation of the innovation throughout the system, and the routinization of the innovation as a standard integral part of the system.

The main role served by adoption is to increase the efficiency and effectiveness of operational programs through selecting and installing innovations.

The school district is the agency which is most likely to be involved in the adoption process. Other agencies which may assist the schools in finding and adopting innovations include resource information centers (such as ERIC, regional service centers, and regional educational laboratories).

FIGURE 6:
ADOPTION, DEVELOPMENT, DIFFUSION AND RESEARCH PROCESSES

	ADOPTION	DEVELOPMENT	DIFFUSION	RESEARCH
DEFINITION	Process of institutionalizing a new program	Process of converting existing knowledge into useful operational programs.	Process of assisting educators to become aware of, assess, and adopt solutions to operating problems	Process of creating new knowledge through scientific methods
GOAL	Convert an innovation into a non-innovation in adopting agencies	Produce improved means to serve educational purposes	Create awareness in adopting agencies of characteristics of innovations	Theory development and verification
SUBPROCESS	Choosing an innovation, building acceptance and credibility for innovations, training of system personnel to use innovations, trial, adaptation, installation, and routinization	Problem explication, invention, design, construction, and assembly	Assessing relevance of innovations, dissemination, and demonstration	Description, correlation, theory development, and theory testing
ROLE	Using innovations to increase program efficiency and effectiveness	Providing means for institutional change	Informing potential adopters of the efficacy of innovations	Produces theoretical opportunities for program improvement
AGENCIES	Schools with help from information centers, service centers, and regional laboratories	Regional labs, industries, publishers, R & D centers	Schools, information centers, industries, regional labs, and state departments	Universities and R & D institutions

Development

The second specific change process to be considered is that of development. In this paper development is defined as the PROCESS OF CONVERTING EXISTING KNOWLEDGE INTO USEFUL, OPERATIONAL PROGRAMS.

The goal of development is the production of improved means to serve educational purposes. Such means include methods, material, equipment, general curriculum, etc.

The development process encompasses at least five subprocesses. The problems to be solved must be explicated. Solutions must be invented. The inventions must be converted into operational designs so that the solution can be given operational form. The components specified in the design must be produced and the developed components must be assembled into an overall operational form of the invention. Clearly, evaluation and decision-making would guide the overall development process from the stage of problem identification through that of assembly and testing of an assembled innovation.

The role served by development is that of providing new means for institutional improvement.

All types of educational agencies are involved in various forms of the development process. However, those which most often carry on rigorous development include regional educational laboratories, industries, publishing houses, and research and development institutions.

Diffusion

Diffusion, the third specific change process to be considered, is defined as the PROCESS OF ASSISTING EDUCATORS TO BECOME AWARE OF, ASSESS, AND ADOPT SOLUTIONS TO LOCALIZED OPERATING PROBLEMS.

The goal of the diffusion process is to create awareness within potential adopting agencies of the existence and operating characteristics of potential solutions to operational problems within the potential adopting agencies.

Diffusion includes three subprocesses. These are assessing the fit of innovations to the problems of potential adopting agencies, disseminating such assessment information to those who have need for it, and demonstrating the operation of the innovation under normal educational circumstances.

The role that is served by diffusion is informing personnel within a potential adopting agency about the efficacy of alternative innovations that they might adopt to serve their particular objectives.

Diffusion is conducted both from within and from outside the potential adopting agencies. Schools must conduct their own diffusion functions if they are to consider a wide range of potentially relevant innovations and if they are to insure the understanding on the part of system personnel of the options under consideration and the relative merits of those options for the local situation. On

the other hand, ERIC centers, industries, regional educational laboratories, and state education departments must do an effective job of diffusion if schools and other educational agencies are to adequately consider the full range of alternative innovations that apply to local problems.

Research

The fourth specific change process to be considered is that of research. It is defined herein as the PROCESS OF CREATING NEW KNOWLEDGE THROUGH THE USE OF SCIENTIFIC METHOD.

The goal of research, therefore, is theory development and verification.

Four subprocesses may be identified for research. They are description, correlation, theory development, and theory testing.

The value of research in programmatic change does not depend upon the researcher's efforts to invent, produce, and diffuse practical solutions to educational problems. Rather, research may be expected to produce theoretical opportunities for programmatic change. However, developers must convert such opportunities into operational realities before research can be expected to have an impact on practice. It should be noted further that while research does not functionally exist to solve local problems, such problems can stimulate research in the general direction of the identified problems.

The agencies most likely to assume major responsibility for research are universities and research and development institutions.

This concludes the descriptions of specific change processes. Next, we turn to the concluding section of the paper in which an attempt will be made to provide general models of the relationships between the general leadership processes of decision-making and evaluation and the specific change processes of adoption, development, diffusion, and research.

PART III

MODELS OF RELATIONSHIPS AMONG GENERAL LEADERSHIP PROCESSES AND SPECIFIC CHANGE PROCESSES

Planning decisions supported by context evaluation determine the objectives for a programmatic change effort. In turn the change objectives determine that nature of the setting in which the programmatic effort is to occur. Both the objectives and the setting affect preconditions for determining which specific change processes should be pursued. Likewise, structuring decisions supported by input evaluation determine the network of specific change process activities which are to be employed to achieve the given objectives. Moreover, implementing and recycling decisions, supported by process and product evaluation, operationally govern the execution of the specific change processes to achieve the goal of the overall programmatic effort.

This overview of the interrelationships among decision-making, evaluation, and specific change processes clearly indicates that there is no standard linear pattern among adoption, development, diffusion, and research that fits all programs of change. Rather, decision-makers must use evaluation to set goals and to choose, implement, and recycle whatever programs of activity seem most conducive to efficient and effective goal achievement. This is the essence of programmatic change.

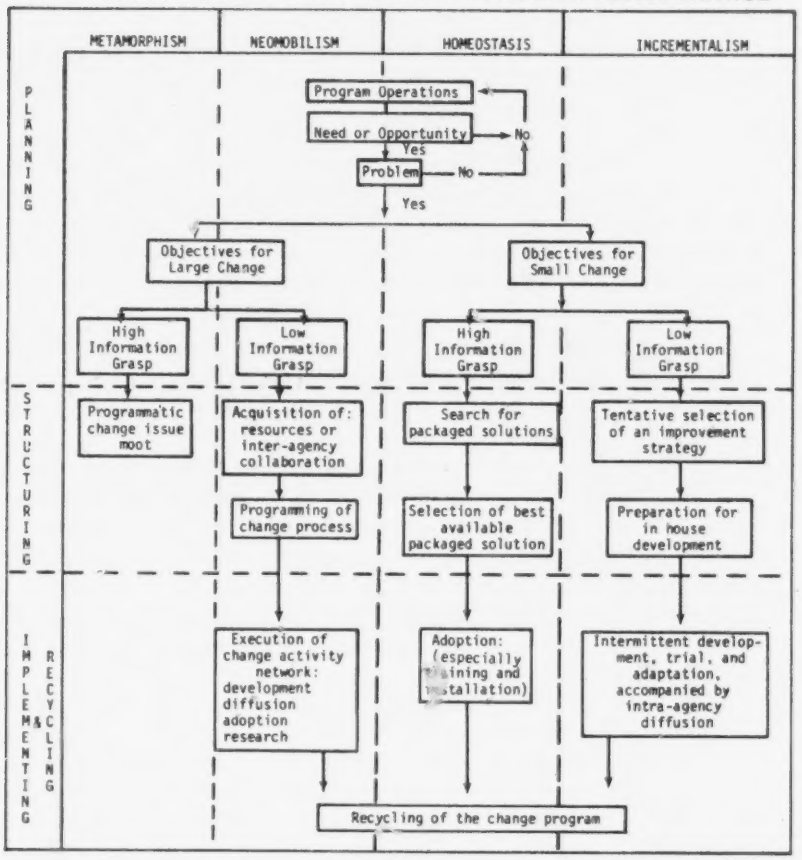
The remainder of this section is devoted to the presentation of two models which depict interrelationships between leadership processes and specific change processes. The first emphasizes the relationship between decision-making on the one hand and adoption, development, diffusion, and research on the other. The concluding model portrays the role of evaluation as intermediary between decision-making and change processes.

A Decision-Oriented Change Model

Figure 7 provides a framework for showing the interrelationships among change settings, decision types, and specific change activities. Basically, the figure contains a flow chart framed within a matrix. The column headings are the four decision settings introduced earlier in the paper: metamorphism, neomobilism, homeostasis, and incrementalism. The row headings are the four decision types: planning, structuring, implementing, and recycling. Implementing and recycling have been included together, since they are both made during the operational stage of a project. Within this framework, the flow chart illustrates how the specific change process of adoption, development, diffusion, and research have differential relevance in the various change settings with respect to working through the four types of decisions in problem-solving activities.

The chart should be read from top to bottom, beginning with the Program Operations block. Problem solving or programmatic change efforts with respect to these program operations begin with the identification of a need or opportunity. When it is decided that a need should be met, or that an opportunity should be used, the planning process is activated. Next, a diagnosis should be made of the problems which prevent needs from being met, or opportunities from being used. Then, change objectives must be established; for example, an objective to have no less than 90 percent of migrant children who are presently eighth graders in a state remain enrolled in secondary school through graduation from the twelfth grade. As shown in the flow chart, such an objective may be classified as a large or small change. In the minds of the decision-maker and the relevant public, does the objective involve significant changes in important variables? The objective in the example would probably fall within the category of large change within states such as Texas and California. If a change is classified as large, subsequent change activities will be either metamorphic or neomobilistic. If classified as small, the future change activities will be either homeostatic or incremental. The final step in the area of planning decisions is determining the

FIGURE 7:
A FLOW CHART OF DECISION-MAKING IN PROGRAMMATIC CHANGE



extent to which adequate information exists to support the selected change objective. To what extent does the decision-maker know how best to effect the desired change? Based upon his answer, he may follow one of four decision-making streams. If he were attempting to effect changes judged large, and if he decided that he has all of the information required to effect them, he would theoretically follow the metamorphic stream. (The position stated in this paper, however, is that this situation only has theoretical relevance, so that no attempt has been made to select or devise a set of specific change processes which can be used to guide metamorphic decision processes.) If the decision-maker is attempting to effect large changes and decides that he lacks the information needed to effect them, he will follow the neomobilistic stream. If attempting small changes

in the presence of high information to support them, he will follow the homeostatic stream; and in the face of low information, he will follow the incremental stream.

Once the nature of the planning decision has been determined, attention shifts to the area of structuring decisions. From the available specific change processes, the decision-maker implicitly chooses the ones that he will employ. Neomobilistic change would require a complex network of activities, possibly involving all four specific change processes. Homeostatic change would likely involve only adoption activities since the main point here is to maintain the normal balance in the regular program through the selection and implementation of the best available solution. Incremental change would involve local developmental (trial and error) activities, since only small improvements are required and since satisfactory packaged solutions are not known to exist.

The remainder of Figure 7 is worked out in accordance with these recommendations. However, decision-makers in any change setting may choose and follow any of a large number of possible configurations of specific change processes.

With the choice and structuring of specific decision processes, the decision-maker is ready to carry through his change program; he moves from structuring decisions into the realm of implementing and recycling decisions. Tasks pertinent to these types of decisions vary greatly depending upon the change setting.

For the neomobilistic change setting, the decision-maker must be concerned about the procedures and objectives that are associated with the research, development, diffusion, and adoption phases of the change process. The many substeps of these processes which may be involved make the decision-maker's task potentially very complex. Decision-makers who work in neomobilistic settings must obtain and use a great deal of information about process and products of these change steps; they often must coordinate the activities of many agencies over a relatively long span of time toward the accomplishment of very difficult, complex, and little understood tasks.

For the homeostatic setting, the decision-maker's implementing and recycling decisions are few and relatively easy to negotiate. Under the interpretation used in this paper, the decision-maker has chosen a solution that he knows will work and which is already developed and in a packaged form. His major concerns are orientation and training of staff for implementation of the solution and for its actual installation. To service these two tasks, he would probably require only a small amount of process and product data, since he is quite certain on *a priori* grounds that no major problems will be encountered in putting the solution into effect.

For the incremental setting, the decision-maker's implementing and recycling decisions amount to those of trial and adaptation. He puts the selected change procedure into effect, reflects on its operation, adapts or adjusts it, again

reflects on the results, etc. While the decision-maker needs continuous feedback about the results of the various modifications he introduces, he probably can avoid going to much expense to obtain this information.

With the completion of the implementing and recycling decisions, the execution of a change strategy through a particular set of specific change processes is complete. Presumably, the need or opportunity which motivated the change procedure has received an appropriate response. Thus, the decision-maker focuses his attention once again exclusively on the total program. And, the program assumes a steady state until the next need to be met or opportunity to be used is identified.

An Evaluation-Oriented Change Model

Figure 8 presents an evaluation-based model for programmatic educational change. This chart retains the basic relationships between decision-making and evaluation which have been described previously in this paper. Additionally the figure portrays the fundamental role of evaluation in servicing decision- making in programs of change. The chart provides for systematic context evaluation and ad hoc input, process, and product evaluation. The small loop (=⊃) attached to each evaluation block denotes the general procedure of delineating, obtaining, and providing information that was projected in Figure 3.

The outer cycle represents a continuous, systematic context evaluation mechanism that provides both congruence and contingency context data. This mechanism delineates, obtains, and provides information to the planning body of a system to make decisions either to change the system or to continue with present procedures because they are serving important objectives effectively and efficiently. If the context evaluation indicates no discrepancies between the intentions and actualities or between possibilities and probabilities, the planning body might feel confident to continue at the same level.

However, if the context evaluation indicated a deficiency or identified some unused opportunities for improvement, a rational decision-making body would probably decide to bring about changes in accordance. Such changes can be of three types.

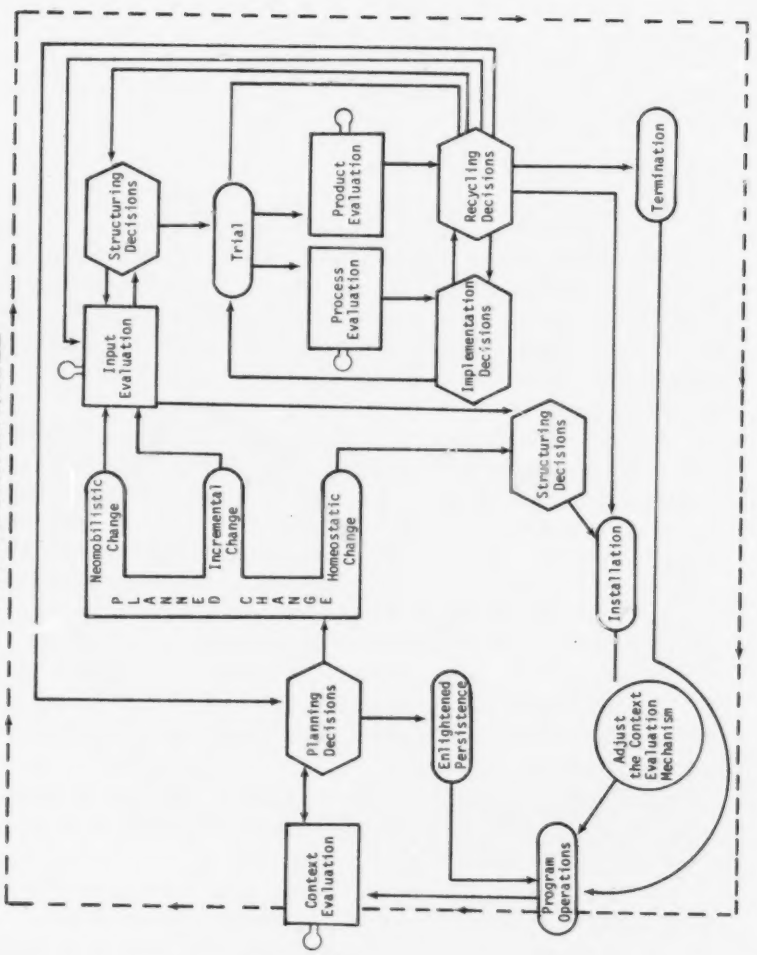
1) Homeostatic change would be based upon decisions to effect small changes supported by a high level of relevant information grasp on the part of relevant program personnel.

2) Incremental change would be based upon decisions to effect a small change supported by an initially low level of relevant information grasp.

3) Neomobilistic change would be based upon decisions to effect large change supported by an initially low level of relevant information grasp.

Depending upon the type of change to result from planning decisions, vastly different evaluation measures might be called for. In response to homeostatic change, where adequate information to support decision-making is already available from the research literature and/or the context evaluation mechanism,

FIGURE 8:
AN EVALUATION MODEL



an expensive evaluation study to provide redundant information would be unwise. Therefore, the model in Figure 8 shows: (1) that decision-makers would make structuring decisions regarding the means necessary to bring about homeostatic change without any intervening formal evaluation support mechanism other than context evaluation, and (2) that these structuring decisions would lead directly to installation of change in the program and subsequent adjustment to the context evaluation mechanism to provide for routinely monitoring the new feature in the system by the systematic context evaluation.

If neomobilistic or incremental changes are called for, ad hoc evaluation mechanisms to support such change are definitely needed, since both the context evaluation mechanism and the research literature provide inadequate supplies of information to support these types of changes.

First, an input evaluation study must be done to identify and evaluate strategies and procedures to effect desired changes. Such input evaluation information should assist decision-makers to make decisions in designing desired change procedures. As already noted, neomobilistically oriented input evaluations will be much more highly structured than incrementally oriented input evaluations. Upon completion, the structuring decisions usually lead to some kind of a trial or pilot phase because the desired change is still an innovation and has not been adequately tested; therefore, it is not ready for installation in the total system. However, structuring decisions can bypass trial projects and lead to the installation of change procedures in the overall system.

Process and product evaluation are included next to aid decisions pertaining to the trial phase. Process evaluation would provide information for decisions involved in efficient implementation of the trial, including the modification of previous structuring decisions as necessary. Product evaluation would go on simultaneously throughout the trial in conjunction with process evaluation and would support recycling decisions leading to a reformulation of the change to be brought about, modification either in strategy or procedure, termination of the change effort, or installation of the innovation in the total system. In the case of installation, again, the context evaluation mechanism would be adjusted to allow systematic monitoring of the new element in the total system and, thereby, to assess its generalized impact.

CONCLUDING STATEMENT

In conclusion, this paper has tried to identify, define, and interrelate the basic concepts of programmatic educational change. The paper defined programmatic change as that change which occurs according to a schedule or system under which action is taken toward a desired goal. This definition was further explained through the identification of leadership and specific change processes

which are involved in determining desired goals and designing and implementing systems of procedures for achieving the goals.

The leadership processes which were identified included decision-making and evaluation. The specific change processes which were identified included adoption, development, diffusion, and research. Both the leadership and change processes were defined and described.

The final part of the paper presented two models of the relationships among the conceptualized general leadership processes and the specific change processes. The first model depicted the role of specific change processes within an overall decision-making framework. The concluding model portrayed the essential dependence of decision-making and change processes on systematic proactive evaluation. This concluding model is suggested as an overall model for programmatic change.

REFERENCES

Braybrooke, David and Lindblom, Charles E., *A Strategy of Decision* (New York: The Free Press, 1963). This most insightful work is based on the authors' wide experience in the arena of public policy decision-making. A significant portion of the book is taken up with a discussion of the inadequacies of ordinary formulations of decision-making processes, which treat decision-making as rational. Braybrooke and Lindblom instead espouse a strategy of decision-making which they term "disjointed incrementalism," and which is based on the lower left quadrant of Figure 1 (q.v.), called "incrementalism" by us. We believe that the educational situation is sufficiently different from that normally encountered in public policy arenas to make viable certain decision strategies in the upper left and lower right quadrants of Figure 1 (homeostatis and neomobilism), which quardrants Braybrooke and Lindblom believe have little utility in guiding policy decision strategies in most cases. It is chiefly in this regard that we differ from their formulations. We acknowledge a great indebtedness to them for the concepts of high vs. low change and high vs. low understanding, which form the basis for the strategies implied in Figure 1 and which are further explicated in the text.

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II
SOME CONCEPTIONS OF PROGRAMMATIC R & D

Hendrik D. Gideonse[5]

I was asked to speak to the definition and description of programmatic research and development. I come to this task from the perspective of a research planner and administrator. I am not a performer or producer of research and development. I say this not because being a planner or manager disqualifies me from saying anything intelligent on the subject, but because it does constitute my particular frame of reference.

Besides identifying myself as a planner and administrator, I should also articulate my conviction that defining programmatic research and development is not an empirical task so much as it is a policy problem. Programmatic R & D is not something to be discovered and described so much as it is something to be determined and defined. We are not looking for something "real" out there and describing what we find. Rather, the definitional task is purposive and intentional in character. It is a case of deciding what is required or desired and establishing the procedures and criteria which would best help to create the type of R & D we are trying to call into existence.

(In beginning the analysis, it is probably useful to note that the term programmatic is generally used to mean "something other than project." In other words, it is usually meant to imply more than a single project, a relatively long time frame, and a justification which extends beyond the purposes of individual project components.)

The proposition I would like to present is that programmatic research and development can be usefully defined in terms of the objectives or goals toward which it is aimed. Programmatic R & D can also be defined in terms of the external processes which characterize it. My presentation, however, is a beginning attempt to define and describe three alternative kinds of objectives, and to

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develop the different criteria and requirements which characterize each. The three types of programmatic R & D, or more accurately, the three different types of objectives toward which we might design appropriate programmatic R & D efforts, are not the only types which might be developed. Other schemas and variations might be just as easily developed. But presented here are three which I and my colleagues have developed as heuristics to guide various planning activities which we have undertaken in recent months.

The examples developed in this paper are conceptual. To our knowledge there are few if any instances in "real life" which look just like them. They are analytical abstractions or composites of best cases. I cannot even at this point make any claim that these prescriptions should be followed or that, if they were to be followed, it would be possible to implement successfully anything like them in real R & D situations. It is with these cautions that the three examples of programmatic R & D are developed here as ideal types. I believe they are suggestive of some of the major directions in which we probably ought to be moving in educational research, as dollar resources increase, as our sophistication in research management gradually improves, and as the demands for useful products, processes, or outcomes continue to expand.

The definition of three different kinds of objectives can help create useful parameters within which programmatic research and development can be discussed. I propose assigning the names "end state," "product," and "area" as short-hand labels for these objectives. If you will refer to Figure 1, the differences between these types of objectives will perhaps rest more firmly in mind as my exposition continues. I will first define all three of the objectives, and then develop more detailed expositions of what the requirements of programmatic R & D oriented to each of the three would be like.

An "end state" objective of programmatic research and development is one which is identified in terms of trying to achieve something out there for clients. Clients may be conceived as ultimate clients in the sense of the young people who are individually served by education or social institutions of many kinds, who have need of the skills and attitudes that education is supposed to add to young people as the result of the operations it performs in their behalf. Clients may also be conceived as intermediate (e.g., teachers, administrators) in the sense of the educational system. The central aim of this objective is producing the actual change or condition that is identified in the description of the desired end state. The objective in end state programmatic R & D is reaching a desired state of affairs in a client system or for a client population. The desired state of affairs should be publicly stated in terms which will allow its achievement, when that occurs, to be clear, explicit, and observable. End state objectives will always refer to a target population, either learners or practitioners. Two examples of end state objectives are:

1) 90 percent of ninth grade pupils will read at 90 percent level of competency as measured by X test;

FIGURE 1:
SOME ALTERNATIVE CONCEPTIONS OF PROGRAMMATIC R & D

END STATE	PRODUCT	AREA
OBJECTIVE: Achieving actual designated change in client system or direct population.	OBJECTIVE: Create a product, process or technique which when used in a specific fashion yields specified outcomes.	OBJECTIVE: To create knowledge and test development strategies on the basis of which "product" or "end state" objectives can be identified.
Define target population	Define product, process or technique	Is the area defined?
State desired change and how measured	Define outcomes it is to produce	What is the justification for the importance of the area?
How broad is consensus? How can it be produced?	Define target population(s)	Why an "area" program? Is knowledge weak? Absence of developmental strategies?
What is nature of endorsement?	What is justification for product?	Where is work being done in the area?
What are the planning procedures to be used?	What are the knowledge assumptions on which product is based?	What capabilities need developing?
What does the logic network look like?	What is the development strategy?	Do program implementation techniques give promise of cultivating serendipity?
Have failure routes been identified?	Who are potential users and is there user support for the objectives?	Are there provisions for information brokerage functions?
Are there provisions for recycling?	Is a developmental logic laid out showing a defined sequence of events?	Are there provisions for periodically assessing programs in the area?
Is there an adequate information system?	Are interim objectives defined?	
Are institutions and individuals available to do the work?	Where does the institutional and individual capability exist to complete the objective?	
If not, are provisions made for creating the capability?	Are there cost estimates based on past management history?	
What are the cost estimates?	Are there adequate provisions for program control?	
What are provisions for program monitoring, implementation, and control?		

2) X percent of operating school districts over Y size will be using computer techniques for scheduling, staff assignment, purchasing, and operations analysis at a cost of $Z per pupil.

A "product" objective of programmatic R & D is one which is defined in terms of the creation of a product, process, or technique which when used in a specified fashion yields specified outcomes in a client population or practitioner system. The product or the outcomes it is intended to produce in learners or practitioners must be described in a way that the achievement of same can be demonstrated and measured. Two examples of product objectives are:

1) An instuctional system to teach English to a specified target population to a level of competence indicated by X level of performance on test Y;
2) A computer utility capable of serving 100 school systems in a 50 mile radius at a cost of $N per pupil providing services G, M, N, and O.

An "area" objective for programmatic research and development is to create knowledge and test development strategies, on the basis of which "products" or "end state" objectives can ultimately be conceived, decided upon, and achieved. The area in question needs to be defined fairly carefully so that the resulting program of R & D has sufficient focus. The terms used to identify areas define the boundaries within which work will take place. Such terms are typically unidimensional in that they refer to a curriculum area, a stage in human development, or a particular functional category within the practice of education. Three examples of areas are:

1) Parent mediated learning system;
2) Learning in the affective domain; and
3) School organization and administration.

With these definitions of three different orders of objectives for programmatic R & D in mind (end state, product and area), let me now turn to a more detailed elaboration of the requirements associated with each. The analysis is presented in the form of questions which need to be answered or conditions which need to obtain in order to undertake and achieve successfully the objective identified.

First, let us consider R & D oriented to end state objectives. We will want to know a great number of things and be able to assure the existence of a considerable number of conditions in order to be able to mount an effective programmatic R & D effort. For example, we must be able to describe and define the target population. We must be able to say what this population will be able to do when the end state is reached and how much of a variation from present performance is called for relative to the desired state of affairs. We must be able to say how this new performance will or might be measured.

For any end state objective it is important to know if a broad consensus presently exists around it to insure that all the requisite component agencies and functions (not just R & D) can be orchestrated to achieve the goal. If such a

consensus does not exist what plans have been laid to secure it? Exactly who has endorsed this objective -- federal, state, local and professional groups -- and what is their span of control? It is important also to know what the form of the endorsement is, whether verbal, financial, or structural (e.g., people, plans, administrative organization, etc.).

A number of planning requirements appear particularly important for an end state objective. Have the planning procedures to be employed in the course of achieving this end state been clearly specified? Are those procedures adequate to the task? Have sufficient staff and program resources been allocated to the planning process by those responsible for the management of the effort? Is planning seen as a continuous, recycling activity? Is the proposed R & D part of a larger logic which embraces the entire program from its inception to its final achievement? Is the R & D plan itself presented as a logic network? Are the immediate steps to be taken with the next budget year funds clearly identified? In the R & D plan, is more than one line of research logic being pursued? Have dead ends in the research logic been anticipated and potential alternative courses of action (failure routes) developed and presented? Have sufficient lines of inquiry been developed so that the likelihood of being boxed in is diminished? Managers of programmatic R & D oriented to the production of an end state would need to assure themselves that the criteria for assessing program accomplishments were clearly specified. They would have to be certain that program documents were presented in terms which make them useful as a basis for assessing accountability. They would probably wish to have an information system integral to and responsive to the research logic and the network logic.

In any programmatic effort as broad as an end state objective, institutional and individual capabilities would need to be assessed. Are there individuals and institutions capable of performing the indicated work? If capability doesn't exist, are there plans provided for developing it? Furthermore, in considering the different kinds of work to be done to achieve the end state, is there a clear division of labor among the different possible performers?

Cost estimates are important. What is the evidence that cost estimates are valid and responsibly developed? Is past management history of educational R & D used as a basis for validating costs? Are costs presented for the immediate next steps, the total anticipated R & D effort, and the total end state effort? Are provisions made for periodically identifying new estimates of total cost? Do the officials who have endorsed the end state have familiarity with the total costs presented? Are they aware of the need to make available funds expand to cover the emergent costs?

Finally, there are important questions focusing on program implementation and control. What techniques of program administration are being proposed and why? Do the program monitoring procedures give promise of effectively providing for formative evaluation to assist in ongoing project and network redesign as appropriate? Are provisions specified for collecting, aggregating, and

disaggregating information for the several levels of decision-making? Do the procedures proposed convey a clear understanding of who has responsibility for achievement of which R & D objectives specified as part of the total end state logic network?

Similar questions and conditions can be identified for refining requirements for R & D whose programmatic objective is a product of some kind. Is the product in question clearly and simply defined? Could a layman understand what it will look like and what it will do? Are the outcomes to be achieved by the product or technique when it is completed and successfully installed stated in terms which permit measurement or assessment?

For products as well as end states, target populations need to be specified. What kinds of learner populations are intended? What kinds of practitioners or intermediate target populations (e.g., teachers, parents, etc.) are indicated for the product in question?

Justification requirements for product objectives are somewhat different from those associated with desired end states. We should know why the product is deemed desirable and on what basis the judgment is made that, if successfully produced, the product will be used. We should be clear about the assumptions (knowledge base) on which the proposed objective is based, and how those assumptions have been validated. We need to be clear about the development strategy identified. We should know if there is user support for this objective and who the potential users are. Have they been contacted, for example, in some detail with respect to the desirability and usability of the product?

Planning requirements are again important. The developmental logic must be clearly laid out. A defined sequence of events needs to be projected over time which embraces the full range of activities from inception of the work to the completion of the product. Interim objectives must be identified, and criteria presented for assessing successful completion of interim objectives. Consistent with the product identified, a plan must be developed which demonstrates that, although fully worked out, the managers anticipate the need to recycle the initial planning. Provisions for recycling the specifications for successful development of the product should be anticipated. Finally, failure routes should be identified which permit the salvaging of major portions of the work or which provide for the development of alternative paths of action in the event of component failure or other blockage of some kind.

Respecting institutional and individual capabilities, the key element here is ascertaining that the capability for developing this specific product exists. There should be evidence that existing institutions or individuals have a good chance of succeeding at this objective.

Cost estimates for each task and phase in the development plan need to be established and justified in terms of past management history.

Effective program control and implementation require the existence of management schedules and monitoring procedures which assure the timely collec-

tion of data respecting project activities. Procedures for formative evaluation for purposes of redesign and reformulation must be laid out.

Finally, it is possible to identify some of the key conditions for successful management of an area objective. First, is the area clearly defined? Does the definition make clear what is included and what is excluded? Second, is the justification for the importance of the area clear and convincing? Third, are the reasons for proposing an area objective rather than a product clear and convincing? Is it that the knowledge base is weak, or that developmental strategies are not available or there has been insufficient time to develop political consensus around specific end state objectives?

Again we need to be concerned about individual and institutional capability. How much work is currently ongoing in the area? Where is it being done and by what kinds of people? If capability needs to be created, plans for doing so need to be developed. These should build on the experience of past efforts to build R & D capability in the field of education.

Regarding the substance of the specific efforts proposed to be undertaken, it is important that these be related closely to either the reasons for choosing the area, or the judgment about the adequacy of the knowledge base and development strategies, or both. The anticipated sequence of future events based on the outcomes of the first round of activity should be identified.

Program implementation and control under an area objective are somewhat different. Here, instead of aiming at known quantities, management is in a sense oriented toward the achievement of serendipity. There must be provision for stimulating information brokerage functions among R & D performers. The conceptual requirements associated with development in the area must be defined and provisions made for undertaking them. Procedures should be identified for periodically assessing whether or not the area is ready to begin defining products or contributing to end state objectives.

The requirements for conceiving, justifying, and implementing programmatic R & D efforts for these three different types of objectives are sketched in rather lightly; much more could be said and should be said. It has been my purpose, though, to illustrate by hitting the highlights rather than by attempting exhaustive detail.

The analysis suggests a number of things. One is that scale of effort is a key determinant in the identification of management requirements associated with various kinds of programmatic R & D. Achieving a desired end state imposes constraints on managers that go considerably beyond the requirements of the research and development as such. A second point that might be made is that it makes a good deal of difference whether what is to be accomplished is known or determined in advance. End state and product objectives require considerably different management styles and philosophies than programmatic efforts oriented to areas. In the case of the first two types of objectives, management strategies are essentially convergent, but for area objectives the results are

not known in advance, are essentially divergent in character, and oriented, as I suggested before, to the cultivation of serendipity. For the first two kinds of objectives, decision-criteria are to a large extent predetermined; for the third type of objective they would be much more emergent.

Most important, however, I think even this sketchy analysis demonstrates how important the character of the objective of the programmatic R & D effort is in determining what the nature of that R & D program is to be. End state, product, or area objectives impose different kinds of management constraints and requirements. They require different approaches to the identification, availability, and development of manpower. They lead to different information flow requirements within the R & D effort, and, finally, they suggest significantly different relationships between the research and development community and the larger political and institutional environment within which educational functions are performed.

III

THE CONVERGENCE TECHNIQUE: AN ALTERNATIVE STRATEGY FOR PROGRAMMATIC RESEARCH AND DEVELOPMENT

Louis M. Carrese[6]

The concept of programmatic research implies the existence of a purposely formulated plan of action. To many engaged in the conduct of research, the terms "planning" and "research" are incompatible. It is contended that the essential characteristics of research – the probing and exploring in the face of many variables and unknowns--belies the formulation of any structured plan for its conduct.

Currently, many discussions and papers are concerned with attempts to distinguish between the various kinds of research, but for the most part, these attempts have resulted only in compounding a confusion of terms--basic, fundamental, applied, targeted, structured, creative, programmatic, nonprogrammatic, etc. Furthermore, these different kinds of research are discussed in a format of confrontation or as a series of dichotomies--basic versus applied research, structured versus creative research, targeted versus non-targeted research, etc. This kind of discussion can be only endless and fruitless and serve to detract from any meaningfulness these terms could have in an appropriate perspective.

This perspective is one in which both research and planning are viewed as processes and not as discrete, objective categories of activity. Viewed as a process, research extends over a continuum from basic at one end to applied at the other. Viewed as a process, planning extends over a continuum from conceptual model building and experimental design at one end to detailed and precise operations and production planning at the other. In this perspective, the terms we apply to the kinds of research performed become useful and meaningful as frames of reference and provide the basis for determining the degree of maturity of the information generated by research as it evolves across the continuum. Then, the question is not "can research be planned," but "which of the available

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approaches along the planning continuum is most suitable for the organization of the data in the research continuum into an action program."

In any activity in which it is desired to purposely initiate, sustain, and influence actions, some type of planning must take place. The form of the planning can range from the mental organization of data and activities by one person without formalization to a plan on paper, to the construction of an extremely complex PERT chart with thousands of activity nodes. The cardinal point is whereas planning forms the basis for purposeful action, no planning can only lead to reaction and this is as true and undesirable for research as for any other activity.

The Convergence Technique (Carrese and Baker, 1967) was developed to satisfy the planning and programming needs for research clustering around the mid-range of the research continuum which includes a mixture of the elements of basic research and applied research. The currently available planning approaches, primarily the network techniques, are not generally applicable to the planning of research (Brown, 1965; Eisner, 1962; Martino, 1964; Muth and Thompson, 1963; Pocock, 1965; and Roy, 1962). There are four major assumptions made in the use of network techniques in non-research efforts which cannot be made in planning research due to the insufficient maturity of the research data generated in this range of the research continuum.

1) All tasks or activities needed to achieve program objectives can be determined with a high degree of confidence. In research programs not all tasks required to achieve objectives can be determined with the same degree of confidence. Some tasks are based on confirmed and validated knowledge; some are based on tentative implications of ongoing research; others represent the best scientific judgment of investigators working in the area to be planned.

2) All tasks required to achieve objectives are accomplishable, given certain magnitudes of efforts. In research not all tasks are known to be accomplishable. In most cases, the conduct of the program will determine whether or not given tasks, as originally described, can be accomplished. Furthermore, since there is considerable uncertainty that particular research tasks can be accomplished, increasing the magnitude of effort applied to these tasks does not necessarily increase the probability of accomplishment (Roy, 1962).

3) Usable estimates can be made for the duration of each task and time-targets established. Research tasks include many unknown variables and parameters whose impact on the duration of task performance cannot be estimated. As Eisner points out, "It is not sufficient, in discussing the research process to say that the time an activity will take is only statistically determinate; nor is it sufficient to provide a measure of the statistical fluctuations. . .an additional degree of freedom must be provided to deal with the fact that in research, many of the activities are

themselves feasibility studies,. . .attempts to prove or disprove that certain relations exist" (Eisner, 1962).

4) Successful accomplishment of each task in the established network order results in a "positive" benefit to the program (i.e., the program moves forward toward objectives); and successful task accomplishment carries with it the assurance that the objectives of the task are actually achieved. In research, successful performance of planned activities does not insure that established objectives will actually be reached. Success in completing a particular research "event" may either: (1) negate the underlying assumption(s) upon which the work was based; (2) affirm the underlying assumption(s) of the work, usually with the attainment of subobjectives or objectives; or (3) neither negate nor confirm but open up several additional lines of research which should be pursued. In the research environment, one or more of these three outcomes result in a "positive" benefit to the program, but not always in the same obvious incremental manner evident in plans for production or development efforts.

In research efforts, the concept of "ordered sequence" has meaning only as it refers to the logic of scientific aspects for pursuing one of several lines of research for the purpose of acquiring the information base to pursue additional lines of research. This process is repeated until sufficient information is derived to validate or invalidate a particular research assumption or to reach an objective (Eisner, 1962).

The Convergence Technique was developed to utilize some of the general features of the network approaches in the planning of biomedical research, while attempting to minimize some of the difficulties encountered when the more quantified and structured elements of network analysis are applied within a research environment.

Basically, the technique involves the formulation of a series of flows and arrays depicting major research program elements in a hierarchy of phases, steps, and individual projects, sequentially ordered on the basis of research logic, and graphically represented by a model which relates research performance to resources required (including personnel, materials, equipment and facilities, and funds). In the model, present time is represented at the left side of the chart and future time at the right side. The completed model is called a convergence chart. The basic proposition of the Convergence Technique may be stated as follows:

> If the research logic used for the construction of the Convergence plan represents a valid model of the scientific content of the program to be conducted, and if the sequential ordering of the program elements is accomplished on the basis of this logic, then in reality, as research performance moves in the plan from left to right in time, the intermediate objectives of each step and phase will be achieved and the scientific scope of the program will become narrower until all efforts converge on the end point which has been established as the overall program goal.

The concept and symbolism of convergence patterns are more appropriate for research efforts than the approach and language of tight networks. Each step, phase, and array has objectives, but the achievement of these objectives is not necessarily dependent on the accomplishment of all the individual research projects within a given phase or its steps, in a given order. Rather, convergence is realized through the net result of the "research package" represented by a step, phase or array.

The technique is applied through the planning team approach. Based on the experience gained in the planning of major research programs in a variety of areas, two general guidelines can be described for the formation of the planning team.

1) The planning team should not exceed five members whenever practicable. Since the formulation of the logic system and the development of the arrays involve continuous and exhaustive interchange between members, and since agreement must be reached in both the logic and the science of the major program premises, larger groups usually are less productive and also tend to lengthen the planning process.

   It should be emphasized that the planning team does not work in isolation, but must have access to and use the expertise (from both internal and external sources) required in the development of the total program. However, these inputs to the plan are used particularly to improve the earlier versions of the plan worked out by the planning team.

2) The composition of the planning team should provide a balance between generalists and specialists. Although the actual composition of a planning team will vary with the areas of research to be planned, experience has demonstrated that three basic types of individual talents are essential: (1) one person who has a general, comprehensive knowledge of the broad area of research and major scientific disciplines in which the substance of the program to be planned is included (e.g., cancer, virology, nuclear physics, education, etc.); (2) one person with specialized knowledge of and experience in the conduct of research in the particular area to be planned (preferably currently engaged in research and usually the person will be the leader of the new or replanned program); and (3) one person (usually sufficient) with general systems analysis knowledge and direct experience in the use of the planning technique. In addition to this core membership, the selection of other specialists is dictated by the scope of the research activities to be included in the program.

   Experience has also shown that sound formulation of program plans cannot be done very effectively on an intermittent basis. A block of time should be set aside for an uninterrupted, intensive effort devoted to hammering out the plan. Membership on the team should, therefore, remain unchanged throughout the planning period.

The most important initial functions of the planning team are: (1) the selection and formulation of the end goal(s) of the program and a series of major intermediate objectives requisite to the achievement of program goal(s); and (2) the development of the logic system to provide the general framework for the delineation of the type of research efforts to be performed, the determination of the general patterns of research efforts and the logical-sequential order in which research is to be performed, and the establishment of the major interrelationships and interfaces among research elements. For a research area of any complexity and size with many known and unknown variables, these are not easy tasks.

Major goals and objectives should not be described in a diffuse or general manner, e.g., "to cure cancer" or "to study cardiovascular disease" or "to improve the quality of education." The form and degree of detail used in specifying goals and objectives must be neither so gross as to be uninformative nor so fine as to lack perspective. Goals and objectives should be research problems of crucial significance, described in a manner that will serve as the basis for action; otherwise, they remain in the realm of intention. They must be in the form of end results, not of means or mechanics. It is useful, though not essential, to start with the ultimate end objective and work back from it, selecting subobjectives that are judged necessary of attainment to reach the end objectives or goal of the program.

It is important for the planning team to identify and carefully formulate the major scientific assumptions of the plan. Reexamination of these assumptions should be made from time to time as additional knowledge is gained.

Horizontally, the chart is divided into a series of flows (read from left to right in time) representing three basic elements of the total program: research, information, and resources (as shown in Figure 1, an abstracted version of the convergence plan for the Special Virus Leukemia Program). The research flow is typically divided into three arrays: the linear array, the concurrent array, and the supplementary array. The term array is used to signify a series of logically ordered or clustered projects and activities judged necessary to the achievement of particular research objectives. The information and resources flows are not differentiated into arrays.

In the research flow, the linear array represents the lead or main research effort. It is the base line of the research upon which rest all other planned activities. It must include the identification and best possible description of every research activity deemed critical to the achievement of the intermediate objectives and thus converge on the overall program objectives. Although in some instances these will be educated estimates, they must be included. The

substantive content of the linear array should reflect the best and most recent inputs from the research areas involved in the program.

The linear array is constructed as though no research exists in the areas to be planned beyond present time, although major portions of the research may already be in existence. Only after the overall program model has been developed is the determination made (for purposes of implementation) as to which research elements of the program exist or do not exist.

From this frame of reference, the array is linear in characteristic since it depicts the sequential order of research to be performed to achieve program objectives, under conditions where research logic and program chronology are assumed to be the same.

The linear array is constructed by the formulation and sequential ordering of a series of basic logic units representing a hierarchical arrangement of research elements at three levels -- phases, steps, and projects (Figure 2). Each phase represents an intermediate objective deemed necessary for the achievement of the overall program objective and is divided into a series of steps, also sequentially ordered, deemed necessary for the achievement of the intermediate objective. Each step contains the descriptions of individual projects to be performed. These projects are not sequentially ordered but are clustered so as to produce the net research results generated by the combined achievement of several projects rather than the tight sequential achievement of each project. Translation of the program logic represented by the phases and steps into program action takes place at the project level where specifically identified research is described.

A series of decision points are included as integral elements of the linear array. They are part of the basic logic unit and typically appear at the end of each phase, although for certain types of research activity they may be inserted between steps (as shown in Figure 3, an abstracted version of the Cancer Chemotherapy Program Convergence plan). These points represent loci within the program model where assessments, evaluations, correlations, and judgments are made concerning both the progress and output of ongoing research for the purpose of making operating decisions and maintaining and/or modifying the integrity of the program logic.

Each decision point contains two elements: a description of the decision to be made in terms of the intermediate objective represented by the phase title; and a series of criteria that must be satisfied to make the decision. Thus, it represents an assessment of accomplishment and progress. The formulation of the decision points plays a critical role in the construction of the linear array. Based on experience in constructing linear arrays using several different approaches, the following sequence of activities has been found to be most efficient and productive. After the overall objective of the program has been established:

FIGURE 1: ABSTRACTED VERSION OF CONVERGENCE PLAN FOR SPECIAL VIRUS LEUKEMIA PROGRAM

THE SPECIAL VIRUS-LEUKEMIA PROGRAM

		PHASE I. IDENTIFY UNKNOWN VIRUS AGENT AND ESTABLISH REPLICATION				PHASE II: PRODUCTION OF VIRUS	PHASE III: ETIOLOGICAL SUBSTANTIATION AND DEVELOPMENTAL CONTROL WORK	PHASE IV: PLAN AND EXECUTE FIELD TRIALS	PHASE V: CONTROL
		STEP 1. ACQUISITION	STEP 2. SELECTION	STEP 3. TESTING	STEP 4. SCREENING				
RESEARCH FLOW	LINEAR ARRAY	Locate & harvest potentially virus-rich materials from such sources as: Mothers with leukemia &/or leukemic child, high risk occupation groups, laboratory workers, clinicians, patients with Burkitt tumor & their human & animal contacts, erythroleukemics, and others others.	Use fluorescent, electron-microscopy, interference to other detection techniques to select virus-positive materials. Develop means for distinguishing between virus- and pleuro-pneumonia-like organisms.	Determine growth of and disease induction by unidentified human viruses in animals & in cultures of human and animal cells.	Compare physical, biological & chemical properties of unidentified viruses with those of identified viruses.	Produce large quantities of human cancer cells, separate viruses from these cells. Produce large quantities of virus in certain normal human cells.	A. Without inoculating humans, acquire substantial evidence that the suspect virus is associated predominantly with human leukemias. B. Develop an effective, safe vaccine for man. C. Develop other control measures, i.e., eliminate carriers and strengthen human resistance.	Standardize dose regimens in animals; and when appropriate and feasible, vaccinate selected human groups. Monitor selected human groups to evaluate other control measures.	ROUTINE AND WIDESPREAD USE OF PREVENTIVE AND OR CONTROL MEASURES
	CONCURRENT ARRAY	Epidemiological selection of additional suspected virus sources.	Examine other than cancer tissues for viral growth & determine most sensitive methods of viral detection.	Determine growth of and disease induction by identified viruses in animals and in cultures of human and animal cells. Determine effect on viral growth of chemical, viruses & other factors.	Test for and eliminate pleuro-pneumonia-like organisms, other bacteria & contaminating viruses.	Produce large quantities of human & animal cells which will support viral growth.	A. Without inoculating humans, determine whether viruses known to cause other diseases can also be associated with leukemia when combined with other factors. B. Evaluate killed vaccine of animal leukemia virus. C. Correlate level of virus &/or resistance to incidence and type of disease.	Monitor selected populations for change in incidence and/or severity of other diseases.	
	SUPPLEMENTARY ARRAY	Determine biological, chemical, and physical cross relationships among animal and other human leukemia viruses and or antigens.		Develop new procedures and exploit existing factors which enable viruses of one animal species to grow and/or induce disease in other species.		Study relationship of autoimmune state to leukemia.		Production of large quantities of animal and human leukemia viruses and their antibodies in germfree and/or other tissue cultures.	
INFORMATION FLOW		Director of each contract prepares trimester progress/status report for chairman of 7 program segments.		Program segment chairman prepare summary progress/status report covering all projects in their area.		Program segment chairman and science/management team prepare summary status report.		Copies sent to Director, NCI Internal Program Staff, National Advisory Cancer Council, and Project Directors.	
RESOURCES	PERSONNEL	Personnel required for logistical handling of human & animal material.	Provide required number of trained technicians.				Provide required number of field epidemiologists.		
	MATERIALS		Laboratory animals and tissue cultures for virus & antibody production.	Propagate cells from tissue of humans and animals.	Scale up production of mouse leukemic viruses and vaccines.		Scale up production of antisera to reoviruses and human viruses for potential human therapy and immunology studies.		
	EQUIPMENT AND FACILITIES	Adequate number & kinds of equipment for storage of leukemic tissues and other materials.	Separation & concentration equipment, animal facilities for virus production.	Increased production of new-born monkeys, long-term holding facilities.	Expand viral & microbial diagnostic capabilities & facilities.	Expand facilities for separation concentration & purification.	Establish animal testing facility for determining vaccine and/or infective potency of human and animal leukemia viruses.		
	COST								

FIGURE 2:
BASIC LOGIC UNIT – CONVERGENCE TECHNIQUE

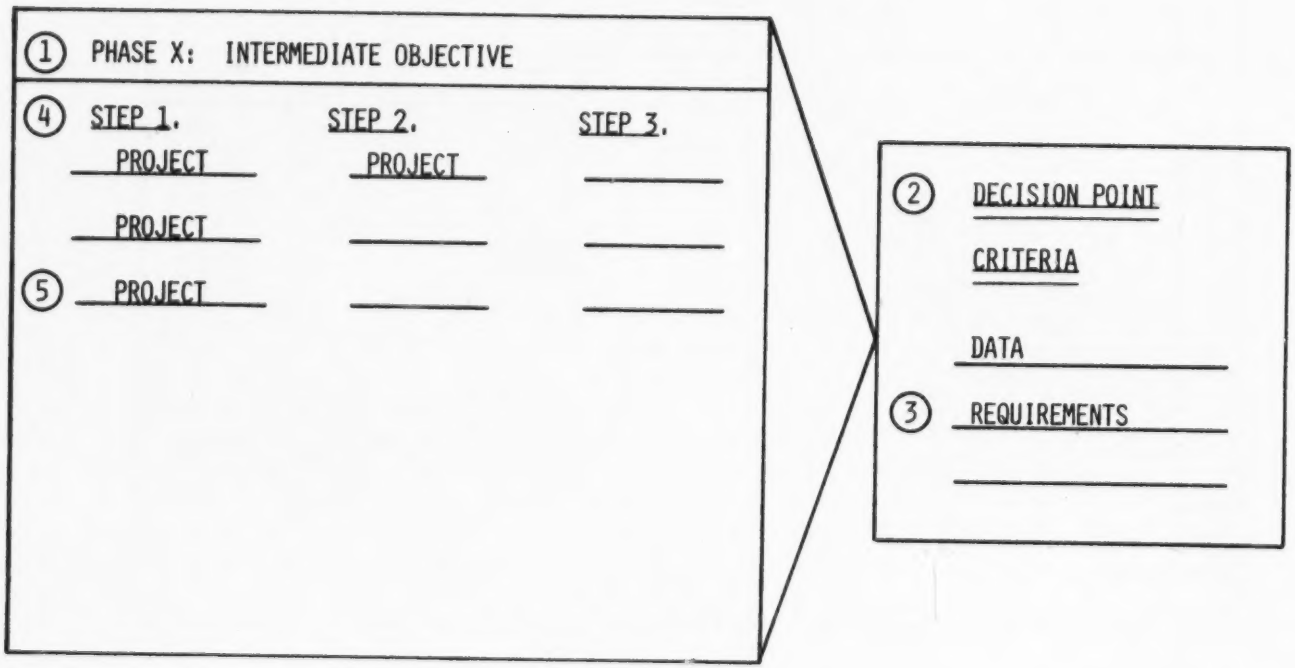
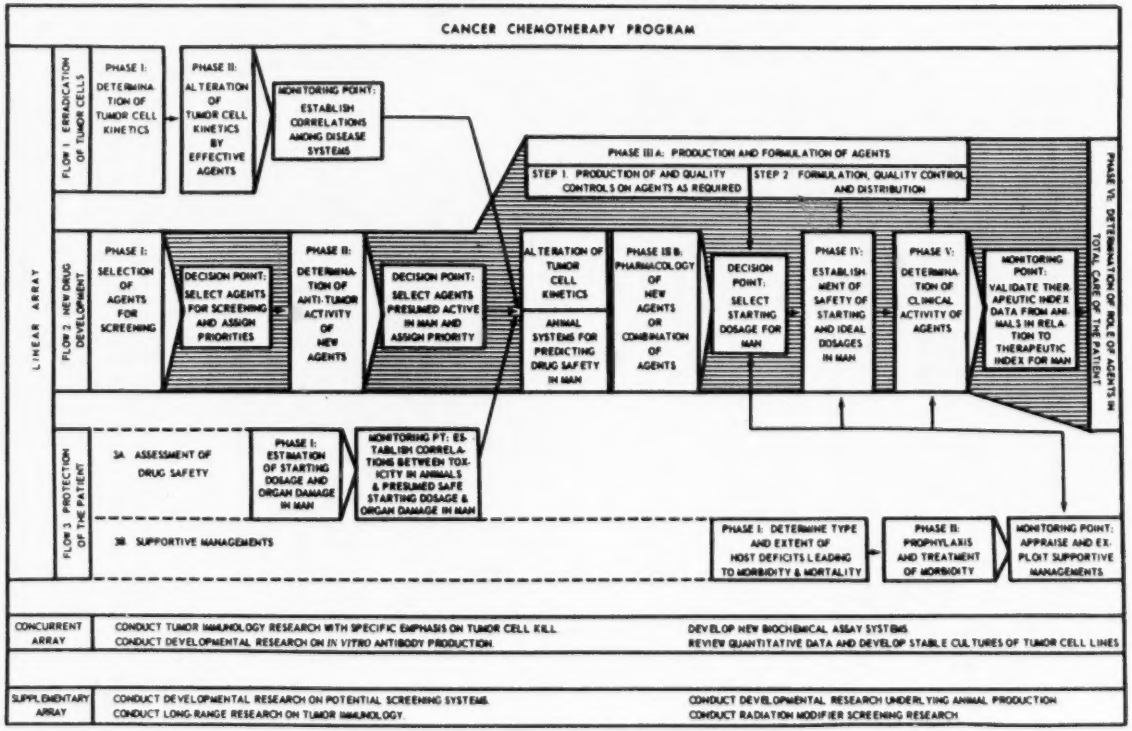


FIGURE 3:
ABSTRACTED VERSION OF THE CONVERGENCE PLAN FOR THE CANCER CHEMOTHERAPY PROGRAM


CANCER CHEMOTHERAPY PROGRAM
LINEAR ARRAY
FLOW 1 ERRADICATION OF TUMOR CELLS
PHASE I: DETERMINATION OF TUMOR CELL KINETICS
PHASE II: ALTERATION OF TUMOR CELL KINETICS BY EFFECTIVE AGENTS
MONITORING POINT: ESTABLISH CORRELATIONS AMONG DISEASE SYSTEMS
PHASE IIIA: PRODUCTION AND FORMULATION OF AGENTS
STEP 1 PRODUCTION OF AND QUALITY CONTROLS ON AGENTS AS REQUIRED
STEP 2 FORMULATION, QUALITY CONTROL AND DISTRIBUTION
PHASE VI: DETERMINATION OF ROLE OF AGENTS IN TOTAL CARE OF THE PATIENT
FLOW 2 NEW DRUG DEVELOPMENT
PHASE I: SELECTION OF AGENTS FOR SCREENING
DECISION POINT: SELECT AGENTS FOR SCREENING AND ASSIGN PRIORITIES
PHASE II: DETERMINATION OF ANTI-TUMOR ACTIVITY OF NEW AGENTS
DECISION POINT: SELECT AGENTS PRESUMED ACTIVE IN MAN AND ASSIGN PRIORITY
ALTERATION OF TUMOR CELL KINETICS
ANIMAL SYSTEMS FOR PREDICTING DRUG SAFETY IN MAN
PHASE IIIB: PHARMACOLOGY OF NEW AGENTS OR COMBINATION OF AGENTS
DECISION POINT: SELECT STARTING DOSAGE FOR MAN
PHASE IV: ESTABLISHMENT OF SAFETY OF STARTING AND IDEAL DOSAGES IN MAN
PHASE V: DETERMINATION OF CLINICAL ACTIVITY OF AGENTS
MONITORING POINT: VALIDATE THERAPEUTIC INDEX DATA FROM ANIMALS IN RELATION TO THERAPEUTIC INDEX FOR MAN
FLOW 3 PROTECTION OF THE PATIENT
3A. ASSESSMENT OF DRUG SAFETY
PHASE I: ESTIMATION OF STARTING DOSAGE AND ORGAN DAMAGE IN MAN
MONITORING PT: ESTABLISH CORRELATIONS BETWEEN TOXICITY IN ANIMALS & PRESUMED SAFE STARTING DOSAGE & ORGAN DAMAGE IN MAN
3B. SUPPORTIVE MANAGEMENTS
PHASE I: DETERMINE TYPE AND EXTENT OF HOST DEFICITS LEADING TO MORBIDITY & MORTALITY
PHASE II: PROPHYLAXIS AND TREATMENT OF MORBIDITY
MONITORING POINT: APPRAISE AND EXPLOIT SUPPORTIVE MANAGEMENTS
CONCURRENT ARRAY
CONDUCT TUMOR IMMUNOLOGY RESEARCH WITH SPECIFIC EMPHASIS ON TUMOR CELL KILL
CONDUCT DEVELOPMENTAL RESEARCH ON IN VITRO ANTIBODY PRODUCTION
DEVELOP NEW BIOCHEMICAL ASSAY SYSTEMS
REVIEW QUANTITATIVE DATA AND DEVELOP STABLE CULTURES OF TUMOR CELL LINES
SUPPLEMENTARY ARRAY
CONDUCT DEVELOPMENTAL RESEARCH ON POTENTIAL SCREENING SYSTEMS
CONDUCT LONG-RANGE RESEARCH ON TUMOR IMMUNOLOGY
CONDUCT DEVELOPMENTAL RESEARCH UNDERLYING ANIMAL PRODUCTION
CONDUCT RADIATION MODIFIER SCREENING RESEARCH

1) Determine the intermediate objectives deemed necessary to achieve the program objective (represented by phase titles) and the logic-sequential order in which they are to be accomplished.

2) Describe the elements of the decision point following each phase with the decision criteria defined in terms of minimally acceptable data (and particular data format) for the satisfaction of these criteria.

3) Then, on the basis of the data requirements specified in the decision criteria, formulate the logic-sequential order of the research steps, and the clusters of individual research projects judged to provide the highest probability of generating the data required to satisfy the decision criteria. Typical phase and step details for the Special Virus Leukemia Program and Cancer Chemotherapy Program are shown in Figures 4 and 5.

When the program is operational, the data generated by the research performed is compared to the data required by the decision criteria. If the minimal acceptable data requirements are satisfied, then the decision can be made to move to the next phase or intermediate objective. If these requirements are not satisfied, then the ongoing research is reevaluated in terms of why it is not producing the required data, the research is modified, or replaced, and the cycle begins again.

Progress or movement in the linear array, therefore, is determined by the ability to make decisions that intermediate objectives have, in fact, been achieved, and this determination can be made only when all decision criteria are satisfied. Thus, in the programmatic context, the research conducted should meet two criteria--it should be excellent in the sense of design and execution as in disciplinary research, but it must also be relevant in the sense of contributing to the achievement of specific program objectives.

The concurrent and supplementary arrays include research projects which are judged not to be critical to the achievement of program objectives, but if resources allow their selection, and if these projects are performed successfully, they will serve to optimize performance in the linear array by providing meaningful inputs. These two arrays do not have their own logic but are dependent on the logic of the linear array. The projects in the concurrent array have more immediate and direct relevance to the research in the linear array.

The projects in the supplementary array represent longer-term, "high risk" projects. Individual projects in the concurrent and supplementary arrays are graphically located on the program chart in positions to indicate general relevance to the major program phases. They may be tied more closely to the steps and/or individual projects if desired. This option is based on the degree of correlation between the arrays desired by the planning team for operational purposes and practical for the size and complexity of the program being planned.

FIGURE 4:
PHASE AND STEP DETAIL, SPECIAL VIRUS LEUKEMIA PROGRAM

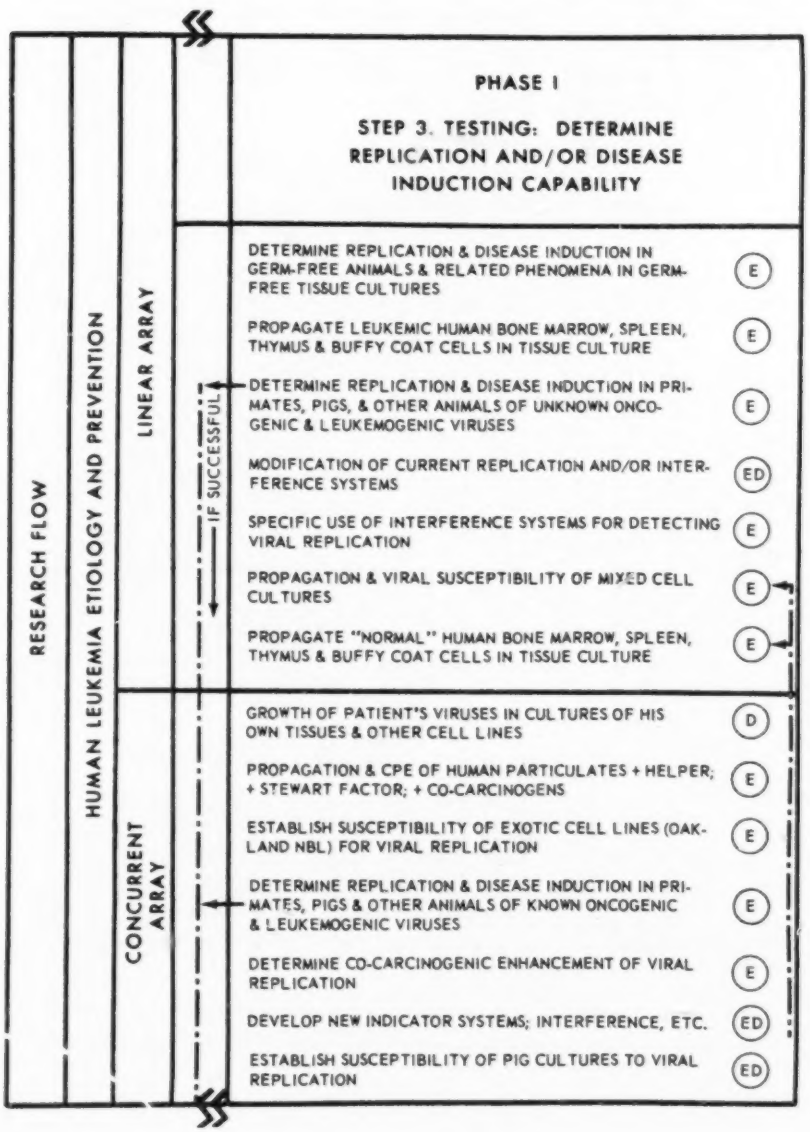
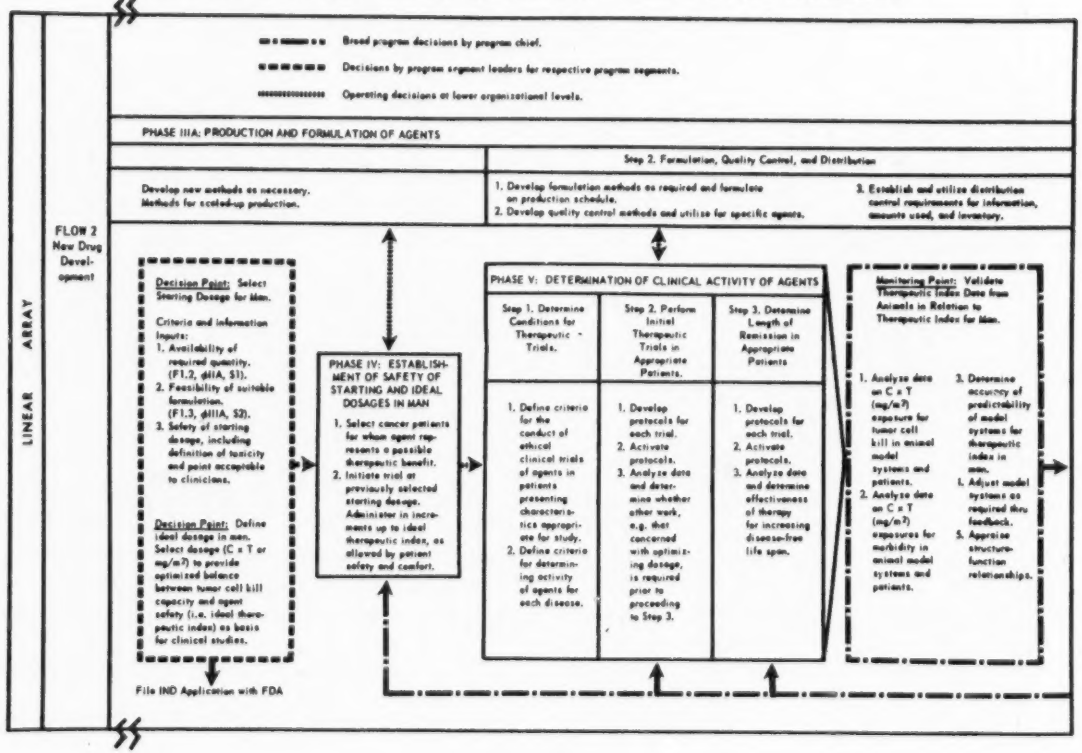

RESEARCH FLOW
HUMAN LEUKEMIA ETIOLOGY AND PREVENTION
LINEAR ARRAY
CONCURRENT ARRAY
IF SUCCESSFUL
PHASE I
STEP 3. TESTING: DETERMINE REPLICATION AND/OR DISEASE INDUCTION CAPABILITY
DETERMINE REPLICATION & DISEASE INDUCTION IN GERM-FREE ANIMALS & RELATED PHENOMENA IN GERM-FREE TISSUE CULTURES (E)
PROPAGATE LEUKEMIC HUMAN BONE MARROW, SPLEEN, THYMUS & BUFFY COAT CELLS IN TISSUE CULTURE (E)
DETERMINE REPLICATION & DISEASE INDUCTION IN PRIMATES, PIGS, & OTHER ANIMALS OF UNKNOWN ONCOGENIC & LEUKEMOGENIC VIRUSES (E)
MODIFICATION OF CURRENT REPLICATION AND/OR INTERFERENCE SYSTEMS (ED)
SPECIFIC USE OF INTERFERENCE SYSTEMS FOR DETECTING VIRAL REPLICATION (E)
PROPAGATION & VIRAL SUSCEPTIBILITY OF MIXED CELL CULTURES (E)
PROPAGATE "NORMAL" HUMAN BONE MARROW, SPLEEN, THYMUS & BUFFY COAT CELLS IN TISSUE CULTURE (E)
GROWTH OF PATIENT'S VIRUSES IN CULTURES OF HIS OWN TISSUES & OTHER CELL LINES (D)
PROPAGATION & CPE OF HUMAN PARTICULATES + HELPER; + STEWART FACTOR; + CO-CARCINOGENS (E)
ESTABLISH SUSCEPTIBILITY OF EXOTIC CELL LINES (OAKLAND NBL) FOR VIRAL REPLICATION (E)
DETERMINE REPLICATION & DISEASE INDUCTION IN PRIMATES, PIGS & OTHER ANIMALS OF KNOWN ONCOGENIC & LEUKEMOGENIC VIRUSES (E)
DETERMINE CO-CARCINOGENIC ENHANCEMENT OF VIRAL REPLICATION (E)
DEVELOP NEW INDICATOR SYSTEMS; INTERFERENCE, ETC. (ED)
ESTABLISH SUSCEPTIBILITY OF PIG CULTURES TO VIRAL REPLICATION (ED)

FIGURE 5:
PHASE AND STEP DETAIL, CANCER CHEMOTHERAPY PROGRAM


Broad program decisions by program chief.
Decisions by program segment leaders for respective program segments.
Operating decisions at lower organizational levels.
PHASE IIIA: PRODUCTION AND FORMULATION OF AGENTS
Step 2. Formulation, Quality Control, and Distribution
Develop new methods as necessary. Methods for scaled-up production.
1. Develop formulation methods as required and formulate on production schedule.
2. Develop quality control methods and utilize for specific agents.
3. Establish and utilize distribution control requirements for information, amounts used, and inventory.
LINEAR ARRAY
FLOW 2 New Drug Development
Decision Point: Select Starting Dosage for Man.
Criteria and information inputs:
1. Availability of required quantity. (F1.2, §IIA, S1).
2. Feasibility of suitable formulation. (F1.3, §IIIA, S2).
3. Safety of starting dosage, including definition of toxicity and point acceptable to clinicians.
Decision Point: Define ideal dosage in man. Select dosage (C x T or mg/m²) to provide optimized balance between tumor cell kill capacity and agent safety (i.e. ideal therapeutic index) as basis for clinical studies.
File IND Application with FDA
PHASE IV: ESTABLISHMENT OF SAFETY OF STARTING AND IDEAL DOSAGES IN MAN
1. Select cancer patients for whom agent represents a possible therapeutic benefit.
2. Initiate trial at previously selected starting dosage. Administer in increments up to ideal therapeutic index, as allowed by patient safety and comfort.
PHASE V: DETERMINATION OF CLINICAL ACTIVITY OF AGENTS
Step 1. Determine Conditions for Therapeutic Trials.
Step 2. Perform Initial Therapeutic Trials in Appropriate Patients.
Step 3. Determine Length of Remission in Appropriate Patients
1. Define criteria for the conduct of ethical clinical trials of agents in patients presenting characteristics appropriate for study.
2. Define criteria for determining activity of agents for each disease.
1. Develop protocols for each trial.
2. Activate protocols.
3. Analyze data and determine whether other work, e.g. that concerned with optimizing dosage, is required prior to proceeding to Step 3.
1. Develop protocols for each trial.
2. Activate protocols.
3. Analyze data and determine effectiveness of therapy for increasing disease-free life span.
Monitoring Point: Validate Therapeutic Index Data from Animals in Relation to Therapeutic Index for Man.
1. Analyze data on C x T (mg/m²) exposure for tumor cell kill in animal model systems and patients.
2. Analyze data on C x T (mg/m²) exposures for morbidity in animal model systems and patients.
3. Determine accuracy of predictability of model systems for therapeutic index in man.
4. Adjust model systems as required thru feedback.
5. Appraise structure-function relationships.

If the linear array was perfectly formulated and if all research contained within it were successfully accomplished, there would be little need for the concurrent and supplementary arrays. In the real world of research, however, this is seldom the case. Therefore, additional projects are needed to optimize and modify the linear array by providing alternative approaches. As the program progresses, research results may point up inadequacies in the logic of the linear array, and projects in the concurrent and supplementary arrays may then become part of the linear array; or some of the more exploratory, potentially high pay-off research projects in the supplementary array may mature at a faster rate than expected and open up new approaches for inclusion in the linear array.

Except under the ideal conditions in which all resources are available to perform all desirable research (that is, the condition of no constraint), decisions must be made regarding which projects are to be selected for performance and how resources, particularly critical resources, are to be applied to the performance of these projects. The trade-off procedures which are utilized effectively to aid in making these decisions in other program environments cannot be applied as directly to research efforts. Nevertheless, the concept of trade-off is necessary and is introduced into the Convergence Technique through the logic inherent in the construction of the various arrays and flows. The three research arrays represent the results of a trade-off process, since their form and content are based on the consideration of alternatives and the rank-ordering of the criticalness of individual projects to the achievement of objectives. Thus, trade-off is accomplished on a continuous basis as the program model is formulated and modified, and results in the three levels of priority represented by the three arrays. This structure provides the basis for operating the program within a spectrum of resource situations. For limited resource situations, only linear array projects would be performed (within the constraints of the sequential order and feasibility of performing certain projects at a given point in time). As more resources become available, projects in the concurrent and supplementary arrays can be implemented – provided that all research feasible in the linear array is under way.

The second major flow to be formulated is the information flow. The information is utilized for the performance of three important functions: (1) to identify the types and sources of information required for or beneficial to the performance of the research (input function); (2) to identify the types of information which should be generated for the purpose of decision-making and program control (output function); and (3) to depict the operational flow for the integration of the various information inputs and outputs across the total program (integrative function). The ingredients of the information flow form the basis for the development of an overall program monitoring system, including the generation of periodic progress reports, their distribution to all participants in the program, and the provision of specific communications networks between several laboratories performing research which requires close coordination. Th:

requirements for monitoring the research conducted in the program are established by the decision criteria developed in the decision points. Research is evaluated with respect to how well required data is being generated.

The third major flow to be formulated is the resources flow. This flow is used to identify the major requirements for conducting the described research in terms of personnel, facilities and equipment, materials and funds. The workup of resources is usually correlated to the step divisions in the linear array by totalling the estimated resource requirements of all projects included in a particular step. In actual program operations, a more accurate and detailed accounting of resources is kept, which reflects all projects implemented (in all arrays and flows) on "working" versions of the convergence chart. The information in the resource flow is very helpful to program operators because it not only provides realistic general estimates of resources, but also makes it possible to look ahead to future resource requirements and estimate "lead times" necessary for their development. This is especially important for resource areas in which development may take two or three years.

When all the arrays and flows have been completed, the final task is the critical overview that transforms a logic model into an operational program plan. This is accomplished in two steps.

First, research interrelationships and interfaces are identified among individual research projects within and among the flows and arrays. This step serves two important functions: (1) it automatically provides for a review of the overall program logic; and (2) in the establishment of interfaces between individual projects, certain dependencies become apparent which may call for re-clustering research activities within certain steps and phases which, in turn, may require restructuring parts of the linear array. In some cases, projects initially included in the concurrent array may now become incorporated in the linear array, and conversely.

Secondly, the entire program is reviewed to determine which of the research efforts described in the individual project statements are, in fact, ongoing, and which are not. The scatter pattern that results from this identification procedure is very helpful in pointing out "gap" areas, or discrepancies, which exist in the real-life situation as opposed to the research logic of the program plan. Furthermore, it provides a sound basis for the establishment of priorities for the selection of new projects to be implemented, since in general it is desirable to fill in the project gaps as they appear in the sequential order established by the steps and phases.

The completed convergence chart has other operational utilities. Since the technique requires the construction of an overall program plan based on the logical arrangement of major research elements, it provides a framework for the organizational structure required to carry out the program. The phase divisions of the logic plan may also represent the best division of program responsibilities for actual operations. The chart provides a succinct program summary that is

very useful when complex programs must be presented briefly, especially to groups not familiar with the full range of the subject matter. The chart is also important for monitoring the program, especially from the broad-scale, overall viewpoint, since many complex interrelationships can be simultaneously considered and reconsidered within the program pattern displayed on the chart.

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IV
A MODEL FOR EDUCATIONAL DEVELOPMENT

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Development in education is achieving identity of its own. Until very recently, references to educational development seldom appeared except when linked to research as a part of R & D. Fusion of development with research is weakening and we can now see signs of the emergence of development as a new professional activity in education. In the very brief time, educational development has gained enormously in status. No longer is it regarded as an afterthought or unwelcome obligation to be met as a means of justifying the cost of doing research, but it is now an important activity with a new discipline.

It is important to note another clearly discernible change in the area traditionally regarded as a part of educational research. This change may also result in the emergence of a separately disciplined activity to be identified as educational evaluation. The enormous problems of providing meaningful information regarding the benefits returned from investments in education are forcing attention to this area. Information that is required for evaluation is not likely to be provided by routine application of research methods and techniques. Basically different roles are to be played by educational research, educational development, and educational evaluation in bringing about desirable changes in the practice of education.

Major improvements in educational practice will be accomplished through deliberate and purposeful action (Hemphill, 1969). Such changes are not likely to just happen. If one is to perform any purposeful act (a change in an educational practice would be an example), he must do three things in sequence. First, he must formulate an intention; i.e., he must visualize a state of affairs which differs from that he believes now exists, and commit himself to bringing it about. Second, he must operate within and upon his environment in whatever

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way he believes will produce the state of affairs he desires. And finally, he must compare the state of affairs that his opertions have caused to exist with the state of affairs that he had intended to achieve to note discrepancies that may remain. These discrepancies then serve as feedback to influence his next intentions and to guide his further action toward desired ends. It does not matter whether a purposeful act is a simple one or a very large and complex one. The same three sequential steps must be taken; that is, an intention must be developed, a set of operations performed and, finally, a comparison made to evaluate the results. The operational phase of a complex act tends to be made up of nested sets of sub-acts. Thus, for example, in carrying out an intention of securing a new position, an individual -- among other sub-acts -- may decide to prepare a resume of his past experience and, within this sub-act, begin by selecting a pencil with which to write. The three phases of purposeful action -- intention, operation, and comparison -- correspond closely to the basic functions of educational research, educational development, and educational evaluation.

To be specific, educational research contributes to educational reform by providing new knowledge to be mixed with experience (i.e., old knowledge) in shaping intentions. In other words, research contributes to the setting of objectives by enlarging the number and kinds of alternatives which one can consider. Desirable change is not likely to be achieved if a state of affairs better than the one which exists cannot be visualized.

Educational development contributes to educational reform by providing a powerful way of changing educational practice. It offers a systematic means of creating new educational products and/or new human capabilities which can produce significant changes. Educational development is the process by which a desired change in educational practice is systematically and deliberately brought about.

Educational evaluation contributes to educational reform by assembling evidence that can sharpen value judgments about given states of affairs, one of which may be regarded as more desirable than the other. It provides information which in systems terms is feedback to guide corrective action to insure that the desired state is indeed attained.

One more introductory caveat needs to be inserted. Reference has been made to educational development as a new discipline. When one refers to a discipline, one is concerned with control, orderliness, a system of rules or methods of conduct, and perhaps efficiency. These are also the basic concerns or purposes of management. Thus, in considering educational development as a new discipline, we will be considering the management of development. Management and discipline will be regarded in this paper as roughly the same thing.

As noted before, the purpose of educational development is to create new and workable alternatives that bring about improvement of educational practice. No one procedure has been found which can provide a "blueprint" for carrying out development; however, some trends in approach to the task can be seen.

Two major approaches that have been identified are product development and change support (Hemphill, 1969).

Product development creates materials, procedures, or devices which--when used as directed--promise to yield desirable and specified outcomes. The emphasis with this approach is on producing proven materials that have a physical identity. A basic assumption of the product-development approach is that school personnel will seek and utilize better materials. It is believed that, since a major block to improved educational practice is the unavailability of such materials, this block needs to be removed in order that improvements in educational practice can occur.

Educational development that is conducted following the change support approach emphasizes intervention in the behavior of educators. Such intervention is not limited to remediation of behavior of individuals through training and encouragement. It may also include rearrangement of relationships among groups and organizations concerned with education, as these in turn affect the behavior of individuals within them. A basic assumption of the change-support approach in development is that improvement of educational practice requires direct intervention in what educators can and will do.

Most of the strategies being employed today in carrying out educational development appear to be mixed ones involving different degrees of use of one or the other of these two basic approaches. The major factor that has influenced the strategy adopted by a particular individual or organization now engaged in development work is likely to be found in the nature of the change or reform to be brought about, or in the background and experience of the individual developers. Opinions and beliefs about how education can be improved far outweigh solid evidence based on evaluated experience about what is the most effective strategy. We can expect, therefore, to see a variety of models for educational development proposed in the next few years, followed by a gradual reduction in the number as only those most fitted to the task survive.

The strategy for the accomplishment of development that underlies the activities of the Far West Laboratory for Educational Research and Development gives priority to the product-development approach and a secondary role to change support. Adoption of this strategy or model for development does not imply that the Laboratory minimizes in any way the importance of support of change. The Laboratory's model for development can be described as a number of stages and steps. Very generally, the strategy is carried out by the following 10 steps:

Stage 1, conceptualization and planning, includes need identification and definition, a thorough review of the research literature and practices that seem to be relevant to the particular need, conceptualization of a product that could contribute to the reduction of the need, a detailed statement of objectives to be achieved through the use of the product, and preparation of initial specifications of the product.

Stage 2, preliminary product design, includes all the work necessary to create the first form of the product. Ingenuity and creativity are brought to bear on the design of what appears to be the most useful product. Frequently, non-Laboratory participants and school personnel are consulted in the design of the product; but such work is certainly more than just putting together a number of pieces or ideas that others outside the Laboratory have tried out. This stage terminates with the decision that the preliminary product is sufficiently well defined and developed to merit preliminary testing. For some products, this preliminary product design may be quite complex and may include a major portion of the development effort; in other instances the preliminary product may be only a very rough approximation of a final product.

In Stage 3, preliminary field testing, the product is tested for its feasibility as an idea. The evaluation is most often conducted using relatively small numbers of representatives of the intended users who may be well acquainted with the problems to which it is directed. The participants in this preliminary field test, or formative test, are generally given the opportunity to respond freely to questions posed by the staff, as well as to draw attention to problems or questions not previously identified.

In Stage 4, preliminary product revision, all necessary changes are made to insure the effective use of the product in actual school use. Decisions about the changes to be made are based on judgments and suggestions made by non-Laboratory participants and the experiences and observations of the staff in the preliminary field-testing stage. Occasionally, these revisions may be so extensive that they amount to a virtual redesign, necessitating a second preliminary field test.

In Stage 5, main field testing, the revised product is tested, using larger samples of representatives of the intended users in actual working situations. The evaluation is conducted quite systematically and is conducted primarily to provide information on its effectiveness in achieving its stated objectives. The main field test is also used to identify ways in which parts of the product might be improved. Generally, the staff members responsible for its development are actively involved in the field test as observers of the process and as coordinators of the field-testing activities of the participants. An additional purpose of this main field test is to identify points at which the users need more, or more specific, directions to insure the product's effectiveness. Following the main field test, decisions are made about possible modifications of the product necessary to correct any deficiencies identified during the evaluation. If the revisions which are made in Stage 6 are quite extensive, the main field test may be repeated to determine the effectiveness of the revised product.

Stage 6, main product revision, usually involves minor modification and the development of support materials necessary to insure that the

product will be entirely self-sufficient when put into operational use. The development of support material, e.g., teacher manuals, coordinator handbooks, user guides, etc., at this point is one way the Laboratory seeks to minimize its involvement in change-support activities. As noted above, occasionally the revisions are so extensive that a second main product test (Stage 5) has to be conducted.

In Stage 7, operational product testing, the materials and processes which constitute the product, together with all supporting materials, are tested in actual use in classroom or school situations without the participation of the staff responsible for its development; that is, the product is tested in the completely realistic setting for which it is ultimately intended. The primary purpose of the operational test is to determine if the product can be used widely in schools without the active support or participation of the staff. This phase is crucial in the development and definition of a product, because the Laboratory--to be consistent with its development orientation--does not wish to provide extensive support services.

Stage 8, operational product revision, includes the correction of any minor deficiencies discovered in the operational test. This stage may also include those revisions judged desirable by the potential product distributor to encourage adoption by schools, provided these changes will not in any way reduce the effectiveness of the product.

Stage 9, dissemination planning, usually requires widely varying amounts of time and effort depending on the nature of the product. Preliminary work on this stage often is initiated simultaneously with Stages 5 or 6. The work generally involves identification of and negotiation with an outside distributor for production and distribution of the final product; occasionally it may be produced by the Laboratory. This stage is terminated after Stage 8, when arrangements for efficient distribution have been completed.

Stage 10, product dissemination, is an open-ended period during which the developed product is being distributed on a large-scale basis to school users. The Laboratory is involved only in a periodic monitoring role to insure that the product is still effective in accomplishing its objectives and that it is generally being used in the way for which it was designed.

These 10 steps provide a general framework within which all of the work of the Laboratory is organized. The work itself is managed in a manner that differs significantly from the one in which research work is managed. Good research work may be managed on a project basis, but effective development work requires program management (Hemphill, 1970).

The basic difference between program management on one hand and project management on the other is the commitment that is made at the outset to

the attainment of objectives in the case of program management and to the execution of a set of predetermined plans in the case of project management.

If one undertakes a program, he commits himself to the achievement of a new state of affairs which is considered more desirable than the present one. Just how that state of affairs is to be achieved is the problem to which a solution is to be found. If the course of action being pursued proves ineffective, then it must be abandoned and replaced with another that promises to be more effective. It follows that the success of a program is measured in terms of attainment of objectives.

In undertaking a project, one commits his resources to the execution of a preplanned set of activities. What comes about as a result of carrying out these plans is not the measure of the effectiveness of the project. A project's outcome usually is unpredictable or at least difficult to anticipate in advance. The measure of effectiveness of a project is to be found in the quality of the execution of a predetermined plan; i.e., the fidelity and efficiency with which the project plan is carried out, not in what its specific outcomes may be.

Research efforts which have the production of new knowledge as their primary purpose can be managed effectively as projects. Thus, for example, a project designed to test the hypothesis that skill Y can be acquired more rapidly if lesson A is presented before lesson B, rather than vice versa, can be carried out without concern as to which of the two sequences does, in fact, prove to be better. Provided that the project plans are of high quality and are faithfully and efficiently carried to conclusion, a project can be said to have been well done regardless of specific outcome.

Unlike the case of a project, the outcomes of a program are of prime importance. If a given plan of work does not result in achievement of a program's objectives, then replanning and redirection of effort is mandatory. The emphasis is on achieving a specified outcome, not on adhering to a predetermined plan. Thus a program to improve the effectiveness of teaching mathematics to children of ages eight through 10 is judged successful only if such improvement actually comes about. Should a teaching method be discovered in the process of carrying out the program which increases the student's interest in science but produces no improvement in mathematical skills, then the program must be regarded as unsuccessful, regardless of the value of the discovery.

The first step in planning a program is to determine precisely what the outcomes of the program are to be. The state of affairs to be realized through the program must be clearly specified. This setting of product specifications, or goal-setting, involves consideration of what is needed or desired, what the present state of the art in relevant areas may be, and what is possible within the limits of available resources. Goals or specifications may be redefined in the program process, as they sometimes must be, but they can never be indefinite or lack precision.

Planning, in the conduct of a program, is a continuous activity throughout its course and can terminate only with the attainment of program objectives (or the abandonment of the program). Planning does not take the form of a final blueprint; rather, each new plan is regarded as a temporary one, subject to revision as information is fed back about the likelihood that a revised course of action will be necessary if objectives are to be attained.

Despite the provisional and temporary status of a plan used in guiding programmatic work, such a plan must be detailed and complete. A broadscale and long-range analysis of the tasks and time required to achieve a program's objectives is an early part of program planning. Each task may then be analyzed into subtasks and into specific activities. A detailed work schedule can be determined and responsibilities assigned to appropriate personnel. A plan or budget is prepared to allocate financial resources. Very detailed refinements of the plans are usually justifiable for only that part of the plan that is to be executed in the near future. It is seldom possible to justify the effort that would be required to develop a detailed plan for work that is to be done far into the future. Feedback of new information is anticipated which will likely render any previous plans useless.

A program plan can be regarded not as a forecast of how the program's objectives are to be achieved, but rather as a description of the long-term strategy and the more immediate tactics with which the effort is to proceed. Therefore, program management creates persistent requirements for information that can guide self-correction. In order to manage his program effectively, the program manager constantly monitors his progress and the use of his resources. For this purpose, he seeks information which falls within two major categories: (1) information about the progress of his program compared with the plan he has established to achieve objectives; and (2) information about the costs of this progress in reference to his resources. Such data provide the basis for (1) frequent reviews of allocation of efforts and adherence to schedules; (2) early judgment about the probable effectiveness of continuing an activity insofar as it may contribute to the achievement of program objectives; and (3) consideration of costs and effectiveness as these factors bear upon the need for change of plan or for choosing among alternative allocation of resources.

Information on the progress of the program is usually provided in some form of a technical progress report prepared by the supervisors or leaders of tasks or components of the program. Such reports are usually most useful if they are made at the occurrence of critical events in the path leading to attainment of objectives, rather than periodically such as monthly or quarterly.

Generally, accounting data provide the information that is needed about the costs of program activities in terms of the use being made of limited resources. A budget or financial plan must be maintained that corresponds with the plan of activities, tasks, and components that make up the program. In developing such a financial plan, the manager anticipates the cost of each task or

program element he expects to undertake during the period of time covered by the plan. His concern is with the cost of the accomplishment of the task, not with whether the resources are used to pay a contractor or to pay salaries or rent, etc. This basic orientation of program management toward financial planning stems from the fact that primary emphasis must be placed upon decisions about what must be done, rather than how the work is to be accomplished, or who is to do it.

An information system supportive of program management yields detailed and timely data about the expenditure of personnel and financial resources. Again, these data must be developed in terms of activities, tasks, and components of the program if they are to provide useful guidance to the manager. A management information system geared to the needs of program management must do more than provide data to facilitate comparison of planned and actual expenditures. It must present such data in a manner that a manager can use effectively to evaluate his program by relating his progress to what that progress has cost his resources. This type of information is what he finds most useful in his constant search for the best means of reaching his program objectives.

When concern focuses on results, it becomes extremely important to (1) specify precisely what outcomes are sought, and (2) measure and evaluate the degree of achievement of objectives.

The need for precise description and specification of program objectives stems from the importance of corrective feedback in management of a program. If one agrees that the activities in which he will be engaged must be those that are most likely to achieve a desired outcome, his decisions must reflect his estimates of the probability of effectiveness of each of his known alternative actions. These estimates in turn must be based upon periodic evaluation of information about discrepancies that remain between the present and the desired state of affairs. The manager also must be able to associate changes in discrepancies (achievement) with the activities in which he has been engaged. At the operating level, these requirements of program management are met by providing (1) detailed and complete specifications of program objectives and (2) systematic formal review of progress.

Despite the many excellent efforts to specify objectives in forms useful to the control of program activities, this task remains one of the most difficult of program management. The arguments for stating objectives in behavioral terms are impossible to ignore, yet the difficulties encountered may tempt one to settle for what he considers less important but more easily specified objectives.

The degree to which one finds it practical to state program objectives in specific behavioral terms appears to increase with the specificity of the activity. Thus, the objective of tasks within components of a program can be defined with more specific reference to behavior than the overall objectives of the component. Likewise, the objectives of a component of a program can be stated with more specific reference to behavior than the objectives of the total program.

Constant monitoring is an integral part of program management at all levels. Since achieving program objectives is an overriding consideration, it is important to the manager that he have up-to-date, detailed, and dependable information about the current status of work in each area of his activity.

In summary, it has been suggested that educational development is emerging as a new professional activity in education with a definite discipline of its own. The new activity cannot be regarded or evaluated as a new form of applied research since it is basically different in its orientation and in the contribution which it promises to make to the improvement of educational practice. A model of the new discipline based on an example provided by the management of the work of the Far West Laboratory for Educational Research and Development has been presented.

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V

MANAGED RESEARCH IN VOCATIONAL EDUCATION

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Vocational education research won an important battle in 1970 when Congress appropriated the full 10 percent authorized by the Vocational Education Amendments of 1968. But we haven't yet won the war. Congress is not really convinced of the value of educational research and development, and a great many vocational educators feel that the 10 percent investment should have been made in some other aspect of the program. Whether we win this coming year's battle, and the following year's, and eventually the war for recognition, will depend in large measure upon the way each year's research-related funds are used.

The purpose of this paper is to advocate a rationale and a procedure for determining how research-related funds should be spent.

The Need for Managed Research

I begin with the assumption that the ultimate reason for all research-related activities in vocational education is to improve the quality of practice in the field. And all vocational educators will agree that the field is plagued with many complex problems which influence the efficiency of vocational education practice – problems which have defied solution for a great many years. Further, in a field like ours, whose rationale, scope, and techniques are being called upon to change rapidly in light of new social values and goals, it is characteristic to encounter problems that we cannot even define sensibly; in other words, we are frequently in the position of not knowing just what we need to know.

Under these conditions, it is vital that a major effort be made to identify our critical research-related goals, to plan how to attain them, and then, in light of the plans, to embark upon systematic, coordinated research-related activities. Significant improvements in vocational education depend upon obtaining solu-

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tions to important, complex problems. Solutions to complex problems demand programmatic, sustained efforts whose component parts or projects are clearly and logically related to each other and which have a cumulative impact. Vocational education, unfortunately, has thus far experienced too much of the alternative; unrelated, episodic activities dependent upon the unique interests of the investigator, which spreads both talent and dollars too thin to lead to visible improvements in the field.

In order to insure programmatic efforts focused upon achieving certain critical goals, funds must be directed to attract and to support the type of research activity needed at a given point-in-time. This requires careful management of research resources. Such management would limit spending to the attainment of a relatively few realistic goals. It would order intended activities for greatest efficiency in attaining goals, and, at the same time, impart a sense of urgency and direction to research and development personnel in order to maximize research-related results.

Effective research management, however, depends upon certain conditions in the field, some of which I shall note only in passing; one of which I shall dwell upon.

Conditions for Managed Research

One of the conditions required for a successful managed research program is a supply of adaptable researchers. This implies that in their training research-related personnel should develop (among other things) a commitment to and knowledge about the totality of vocational education as a field of study, skills in the basic tools and techniques of inquiry, and role expectations that include accepting general directions for their work. These qualities are particularly important to the young men and women who are to be employed by research-related organizations. Those organizations, like the Centers and the Research Coordinating Units, have missions which are determined by and change with the needs of the field; they require professional staff who can and who are willing to adapt to changing organizational missions.

Another prerequisite for an efficiently managed research program at the federal level is close coordination among the offices responsible for administering vocational funds. The parts of the Vocational Education Amendments of 1968 provide for separate authorizations and appropriations for different, but overlapping research-related activities, such as research, development, evaluation, dissemination, and demonstration. The administrative responsibility for the research-related parts of the Act also has been divided. But regardless of these legal and administrative arrangements, continuous improvement in the quality of vocational education inevitably depends upon the combined effects of all kinds of research-related activities. The information produced by research often needs development before it becomes useful, and development without the knowledge yielded from research has small chance of being maximally efficient; evaluation

compares actual with expected program effectiveness and efficiency, while demonstration and dissemination are means for bringing viable alternative educational ideas and products to the attention of researchers, developers, and practitioners alike. It is, therefore, essential that all kinds of research-related activities be planned together for maximum impact, and that procedures for administering them be designed to attain common ends. In the last analysis, neither we nor the public will judge each type of activity separate from the other. What we all want to know is the extent to which their cumulative outcomes have resulted in program improvement.

While integrated planning at the federal level can help insure effective use of the funds controlled by the Commissioner, U.S. Office of Education, obtaining maximum pay-off from the total research-related investment depends upon the voluntary coordination of the states in planning their activities. Each state should, according to its own special needs, consciously supplement or compliment the goals and activities planned at the federal level.

And then, of course, a most helpful condition for managed research is a reasonable level of funding provided at a predicted rate. Long-range planning is hardly facilitated by erratic funding levels.

But the condition about which I am immediately concerned is the availability of an acceptable procedure for establishing research-related goals and planning for their attainment. A procedure is needed that has credibility in the eyes of the profession, that will provide stability and continuity to our efforts, that will coordinate different kinds of research-related activities in the interest of attaining desirable goals, and that will permit ready evaluation of progress toward those goals. Such a procedure must be made visible and explicit, and must have the support of both researchers and practitioners in the field.

A Procedure for R & D Planning

The remainder of the paper will provide the bare outlines of one possible procedure or strategy that may be used at the federal level to systematically identify and select crucial national goals for vocational research-related efforts and then to allocate the resources available to the commissioner to the conduct of programmatic activities designed to attain the goals.

The steps in the procedure include: first, developing a theoretical model of the vocational education system; second, identifying and selecting long-range goals for R & D; third, planning research-related activities; and fourth, allocating resources to research-related activities.

Developing a theoretical model. What's urgently needed in the field, and not only for research-related purposes, is a theoretical model of the vocational education system. Such a model would be an expression of a theory of vocational education; it would depict how the vocational education system should be operating in light of its perceived social role. It would make explicit the inputs, the parts of the system, the desired outputs, and the expected relationships

among the parts. Given such a model, we could then use it as a guide to directing and examining practice. It would be invaluable as a resource for generating meaningful long-range research-related goals and hypotheses aimed at improving the efficiency of the system. And finally, the model would serve as a framework for organizing and applying the results of R & D efforts (and presumably for revising parts of the theoretical model in light of empirical findings).

Vocational education now lacks this kind of a systematic theoretical model. It therefore lacks consistent guidance for both practice and research.

Identifying and selecting long-range goals. For the planning procedure, a theoretical model would help identify critical long-range research-related goals. The differences between what is perceived as ideal practice in the model and the actual practice in the field represent needed improvements. What we need to know or to have in order to bridge that gap are potential research-related goals. For example, the operation of a theoretical model might well require the identification of the potential student body for vocational education each year. In other words, what is the potential student input to the system? The information required about potential students could include number, capacity to learn, readiness to enter training, nature of their occupational development needs, and so forth. In actual practice, however, I know of no state that possesses that kind of information. Consequently, a possible national long-range research-related goal might be "to make available to states, for their possible adoption and immediate application, at least two tested systems for identifying each year the relevant characteristics of their potential student populations for program planning purposes." (Further detailed specifications and criteria indicating when the goal had satisfactorily been attained would probably accompany the goal statement.)

Assuming that many such long-range goals (each with its criteria for satisfactory achievement) can be derived by examining the model, practice, and the state of our knowledge, it is almost inevitable that there will be insufficient human and financial resources to work simultaneously toward all national goals effectively or efficiently. Priorities among long-range goals must therefore be established in light of the relative importance of needs in the field and the contingency or logical relationships among goals. But relative need is judgmental, and the relative efficiency of attaining goals in different sequences is frequently debatable. Consequently, judgments need to be made in the process of assigning priorities to long-range goals.

The judgments are obviously important. Not only do they determine the R & D activity to be supported by the commissioner's funds for a three to 10 year period, but they are also apt to "invent the future," for today's research and development activities will create and shape tomorrow's educational options. Further, the judgments do not require special research expertise, but they do require familiarity with and concern for the operation of the total vocational system. The judgments should therefore be made by the persons who have

responsibility for the operation of the nationwide vocational system – those who run it, who are intimately acquainted with it, who ultimately answer to the public for its efficiency, and who control the mechansims for putting the results of research-related activities into practice. The decision about national priorities for long-range research-related goals should be made collectively by the state directors of vocational education. They best represent the national program of vocational education, and are in an ideal position to insure that the research-related goals in their respective states will supplement and/or compliment national goals. They will become increasingly conversant with the research programs at the national and state levels as they participate in both at the policy-making level.

When determining national goal priorities, the state directors will need assistance. The U.S. Office of Education can serve best by providing staff services to the directors (and by managing the entire research planning process). Before reaching any decisions, the directors will probably want to consult with individuals who bring varying perspectives to the problem. For example, the public's view can be represented by legislators and members of advisory councils. Practitioners from related fields, such as manpower and other areas of education, could be heard. And researchers might help the directors become familiar with the status of our knowledge about the goals under consideration and their contingency relationships.

Planning research-related activities. After selecting the long-range goals that will comprise the targets of the managed research program, it is necessary to plan the kind and sequence of activities that are intended to achieve each of the high priority goals.

One method for doing this, called the "convergence technique," was developed by Louis Carrese and Carl Baker (Carrese and Baker, 1967) specifically for planning and managing research programs conducted by the National Cancer Institute. To apply the technique a team of about three to six members is assigned to each goal. The team would consist of experts in vocational education R & D, in the problem area(s) represented by the particular long-range goal under consideration, and in general systems analysis. The task of the team is to delineate the intermediate goals or objectives necessary for the achievement of the final goal, the sequence in which the intermediate goals logically lead to the final goal, the research-related activities needed to achieve each intermediate goal, and the criteria which must be met in order to conclude that each intermediate goal or objective has been achieved. Thus, while the selection of long-range goals should be made by vocational program administrators, the means to attain the goals must be determined by experts in research-related activities.

The team's task is not simple, and a considerable amount of concentrated time is necessary to forge the plan. Existing knowledge first needs to be examined by the team in light of the long-range goals, and then relevant research-related questions and specifications have to be formulated that repre-

sent a logical progression toward the accomplishment of the pre-specified goal; the sequence may be imposed by the inherent order or structure of the problem itself, by the need for prerequisite information or materials, or even by the immediacy, criticalness or frequency of need in the field. Out of this planning will come what Carrese and Baker call a "linear array" of ordered activities judged to be necessary to the attainment of intermediate and final goals within stipulated standards; in some cases, if the logic requires it, the linear array may branch or contain parallel lines of investigation. In many cases there may be alternative routes to achieving intermediate and long-range goals and the final plan would also show the most promising of them. And, of course, the plan must always be subject to modification by extensive professional review and criticism, changed conditions in the field, and the results of completed activities.

Because current legislation categorizes and limits the kinds of research-related activities for which separate appropriations can be used, and since activities directed toward more than one goal will ordinarily be carried out simultaneously, a second step in planning involves classifying activities and comparing those required by different goals.

To accomplish these ends, the linear planning arrays can be placed in a table. The table rows would consist of the linear arrays for each long-range goal, probably with the array for the highest priority goal in the top row. The columns of the table would then consist of the kinds of research-related activities needed to accomplish educational change, which also correspond to legislative requirements. For example, one column, or group of columns, might be headed "Resource Development" and include such activities as R & D planning, personnel training, creating new research methodologies, strengthening institutions, etc. that might be funded under Part C of the '68 Amendments. A second column might be labeled "Research" and include all the activities which purport to discover, reinforce, or refine knowledge immediately or potentially applicable to vocational education; these activities can also be funded under Part C. A third column could be called "Development" and would include those activities designed to produce and evaluate materials, techniques, processes, hardware, and organizational formats for instruction, permitted under Parts C, D and I of the Amendments. A final column, or group of columns, would be headed "Diffusion," which would consist of the dissemination and demonstration activities possible under Parts C, D and I.

The planned activities of each linear array would then be assigned to the appropriate column(s) within its respective row. It would then be possible to inspect column arrays to detect unnecessary duplications of planned activities for different goals, and to reexamine the priorities of long-range goals in light of any contingency relationship that may be revealed among activities.

Note that there would no longer be any need to debate the relative abstract benefits of research, development and diffusion activities with the pro-

posed planning procedure. Those particular activities needed to accomplish specified high priority goals would be carried out regardless of their nature.

Allocating resources. Finally, once the plan to attain each important long-range goal has been checked in relation to the linear arrays for other goals, and the priority of long-range goals reconsidered in light of anticipated contingency relationships, the linear arrays and their alternatives for high priority goals need to be "priced out" for personnel, facility and cost requirements on a fiscal year basis. This results in a yearly commissioner's budget for research-related activities in vocational education projected three to 10 years into the future. If necessary, the budget can even be cast in terms of allocations to each of the relevant parts of the Amendments.

But among the difficult management decisions that remain is whether or not to request funds for unplanned activities. Similarly, if actual appropriations are less than budgetary requests, what proportion of the available funds should be spent for the planned activities and what, if any, proportion should be left unearmarked to support the most promising proposals that may be submitted on any topic relevant to vocational education?

I would suggest that, at our present low level of sophistication in planning and the current lack of other facilitating conditions in the field, a reasonably large percent of available funds must remain unearmarked. But as rapidly as possible, it is necessary that we move toward utilizing increasing proportions of funds for pre-planned activities. And while it may never be wise to allocate 100 percent of our resources to planned activities, every effort must be made now to begin to gain confidence in using a planning process, to develop a theoretical model for vocational education, to make conditions in the field more amenable to the management of research, and to obtain agreement upon long-range goal priorities.

CONCLUDING STATEMENT

In conclusion, I believe that vocational education's research-related funds can and must be expended more efficiently in the future than in the past. We need carefully planned programmatic efforts directed at pre-selected goals and we must manage available funds so as to make those efforts possible.

While the specific planning procedure outlined has been applied to the federal level, many of the principles suggested can and should be utilized within states as they seek more efficient ways to use the research-related funds at their disposal.

The transition from unmanaged to managed research, however, is not simple. Many facilitating conditions are essential in order to successfully operate a managed research program. A few of the more important conditions have been mentioned herein. But the most critical has been left to the last: I hope Congress has enough patience to give us the time to make the transition.

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VI

PROGRAMMATIC RESEARCH AND DEVELOPMENT AT THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION

Edward J. Morrison[9]

Since Drs. Gideonse and Stufflebeam have discussed what programmatic research and development is and Mr. Carrese and Dr. Hemphill have provided some models for doing it, my ambition is to describe a particular example of programmatic work in vocational and technical education. This description is not arranged to respond point-by-point to the principles and concepts already identified, though you will be able to recognize many of those ideas at work in the example. Rather, it will describe the development of our programmatic work, the major kinds of decisions which were necessary, and the principal mechanisms which have been evolved to operate and manage the effort. Perhaps, some of the ideas, processes and techniques from this admittedly unique operation in vocational and technical education can be useful in other applications.

The Center

The Center for Research and Leadership Development in Vocational and Technical Education is an independent unit of The Ohio State University. It was established in November 1966 with operating funds provided by the Bureau of Research, U.S. Office of Education, under authorization of The Vocational Education Act of 1963, and with substantial contributions for the university, particularly in the forms of capital investments for building and facilities and of long-term commitments to key staff. The Center Director reports to the Provost and Vice-President for Academic Affairs, has the assistance of a council of college deans, and maintains close coordination with all existing programs in related vocational areas and supporting disciplines. A national advisory committee provides continuing counsel and guidance in the development of effective programs to meet educational needs. Ad hoc advisory groups and consultants provide assistance on specific problems, projects and activities. Periodic evaluative reviews of

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The Center's programs and operations are provided by teams appointed by the U.S. Office of Education. The senior staff is a sizeable group of Ph.D's and Ed.D's, all assigned full-time to The Center, representing various specialties in vocational education and in supporting disciplines. Additional people serve full or part-time in such supporting roles as research associates and assistants, technical assistants of various kinds, administrators, secretaries and clerical workers.

Objectives

The Center was established as a mechanism for the performance of several functions needed by vocational education. Thus, its original objectives were stated as functions or processes to be provided:

1) To provide continuing reappraisal of the role and function of vocational and technical education in our democratic society;
2) To stimulate and strengthen state, regional, and national programs of applied research and development directed toward the solution of pressing problems in vocational and technical education;
3) To encourage the development of research to improve vocational and technical education in institutions of higher education and other appropriate settings;
4) To conduct research studies directed toward the development of new knowledge and new applications of existing knowledge in vocational and technical education;
5) To upgrade vocational education leadership (state supervisors, teacher-educators, research specialists, and others) through advanced study and in-service education programs; and
6) To provide a national information retrieval, storage, and dissemination system for vocational and technical education linked with the Educational Research Information Center located in the U.S. Office of Education.

These objectives were useful in describing the kind of organization we were to be and even in getting some activities started. They could provide little guidance, however, in selecting particular research, development, training and dissemination projects. For this purpose, it was clear that we needed objectives stated in terms of the outcomes to be achieved and that we must restrict our efforts to only a few of the very large number of outcome objectives which could be defined within the original process objectives.

General Strategy

A few points of general strategy were agreed upon at the outset to guide our selection of objectives and means for their achievement. Thus, we intended:

1) To effect improvements in vocational-technical education, as practiced, through the development of durable solutions to persistent,

significant problems. This strategy caused us to look first to such sources as state departments, teacher education institutions, and classrooms for problems and needs and to prefer activities related to recognizable problems of educational practice.

2) To take the work of others into full account. This is explicit recognition of our obligation to apply our resources efficiently and contribute to the effectiveness of the total effort to improve education. It led us to select objectives and design activities so as to complement, add to, and capitalize upon other work of The Center as well as of other groups and individuals.

3) To apply maximum leverage on each problem. By this principle, we sought objectives particularly susceptible to application of the talents and other resources available to us and tried to design attacks on those problems so as to obtain the maximum result in practice for a given Center investment. In many instances, this strategy resulted in our being wholesalers rather than retailers. That is, we aimed to provide information, methods, procedures, and models and to work with other agencies to devise means whereby they could replicate and distribute applications of these results effectively.

4) To adapt the mode of attack to fit the problem. Some problems require the development of new knowledge or explanatory principles before they can be reduced in practice. Others may be reduced when methods, materials, or techniques are developed. Still others require training or dissemination efforts. Programmatic efforts often require all of these kinds of activity at one time or another.

In sum, we intended to evolve effective transformations in the vocational education system, to adapt our methods, point of attack and timing for maximum leverage on each selected problem, and to take into full account the work of others so as to apply The Center's unique resources efficiently to the total effort to improve education.

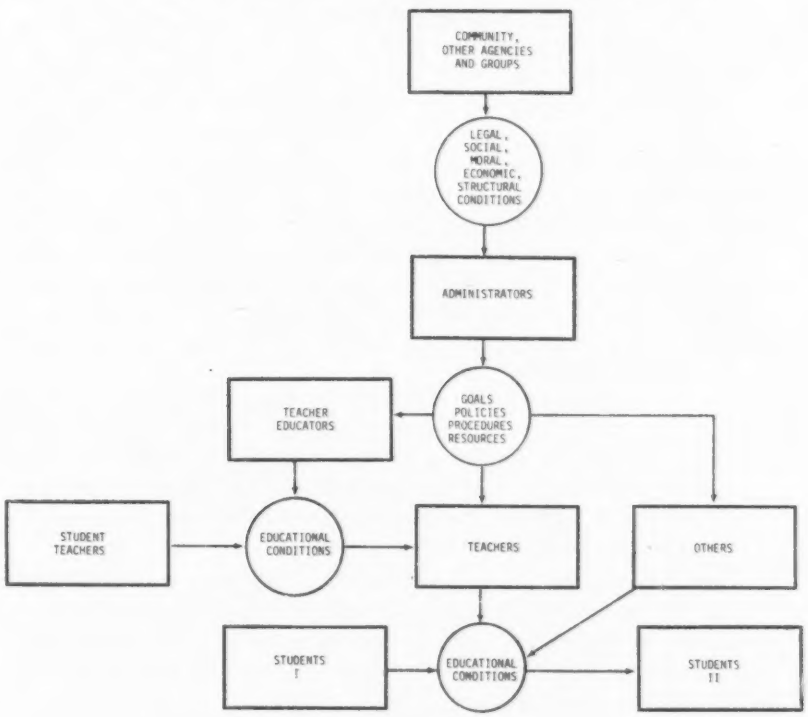
Program Areas

Our search for problems and objectives on which to concentrate our efforts attempted to include information from a wide variety of sources. These sources included not only the standard and non-standard research and professional literature, but also the opinions, plans and counsel of important organizations, individuals and groups. Many large and small conferences, advisory committee meetings, consultations with selected experts, special and exploratory studies, and Center staff meetings contributed to our fund of information about the problems of vocational and technical education.

Our search gradually narrowed to five problem areas which were judged most promising for application of the amounts and kinds of talent and other resources at our disposal. The reasons for choosing these problem areas for more

detailed examination may be more easily understood if we first look at a simplified model of the educational system as shown in Figure 1.

FIGURE 1:
A SIMPLIFIED MODEL OF THE EDUCATIONAL SYSTEM



Several characteristics of this model are worth noting:

1) The model identifies (by rectangles) the principal actors in the system and indicates (by circles and arrows) the major modes by which each acts to affect the education of students.

2) The model is incomplete in several respects (e.g., it omits feedback, levels of administration, specification of various "others," preparation of "others," teacher-educators, and administrators), but it does preserve three important characteristics of the fully-described system:

a) The entire system is designed to transform students from some entering State I to some desired end State II. Its success as a system depends upon its accomplishment of that transformation or,

more realistically, a whole set of desired transformations, and upon the efficiency with which the transformation is accomplished.

b) The key to the system is "Student II." Specification of the desired products of the system, the objectives, stated as capabilities to be achieved by students, not only identifies the system as vocational or college prep or general or whatever, but also defines the transformation required and provides a basis for designing educational conditions to accomplish that transformation. The necessary educational conditions, in turn, determine the appropriate behaviors and training of teachers, and of "others," the selection of policies, procedures, and allocation of resources by administrators within the prevailing operation conditions.

c) The model suggests an hierarchical structure in which each higher level affects larger numbers of actors at lower levels, but less directly and less precisely.

3) Changes in education might be effected by working with any element of the system. A host of problems is available at each point. Our task was to select one or more programs promising maximum effect from the application of the amount and kind of talent and other resources at our disposal. Our initial choice was to consider an attack at each level of the system (administration, teaching, and other student contact and educational practice), but to do so selectively.

In our simplified model, we showed only one box for administrators. Of course, there are numerous levels of administration in vocational-technical education ranging from department heads in a school to the state director. We chose the area of improving the effectiveness of management systems for state-level leadership for several reasons. First, education is a state responsibility. Second, goals, policies, procedures, resource allocations and reward systems established by state leaders can provide tremendous leverage on educational practice and to a substantial degree the effectiveness and efficiency of the system. Finally, early studies showed that the management tools needed to meet the new demands forming on the horizon were not available to administrators.

Personnel development was a second problem area selected. By "personnel" is meant here all those required to man the educational system. This area was chosen, first, because of the great leverage it provides on the education of vocational-technical students. Each teacher, for example, establishes and manipulates the educational conditions affecting many hundreds of students during his career. It is, therefore, essential that his preparation be effective in developing critical skills. Second, the development of educational technology and the evolution of alternatives to traditional school operation are rapidly modifying the roles and necessary skills and knowledges of teachers, administrators, counselors, and all who participate in delivering educational service. Third, a substantial shortage was developing in both vocational teachers and teacher-educators, so

more efficient methods were needed for recruiting and preparing teachers. Finally, our early investigations revealed that substantial changes were underway in the roles state leaders were expected to play, that many current incumbents of leadership positions were ill-prepared for the anticipated changes, and that few potential holders of those positions were being prepared for the roles expected of them.

It is at the level I called educational practice that most research and development in this country is directed and to which the largest commitments of money and talent have been made. Probably, this is inevitable, since developments here are very expensive and time-consuming, and proper, because this is the heart of education. Nevertheless, the large amount of activity and the large costs associated with R & D, especially D, in instructional and supporting systems constrained us to be very selective. We chose three problem areas for which our estimates indicated that we could meet important needs, complementing the work of others, and achieve our goal of good leverage.

Thus, we chose to explore curriculum as a problem area, but to limit ourselves primarily to the methods and techniques of vocational instructional systems design. Since vocational education is what happens to the student -- the objectives for which he strives, the objects and materials with which he works, and the conditions affecting him – and because a curriculum change can affect the education of many thousands of students, the instructional system clearly seemed to deserve consideration by a Center determined to improve vocational and technical education.

A second problem area selected at the level of educational practice was vocational development and adjustment. This area was chosen because the evidence is that vocational competence is much broader than the possession of specific job skills. Many "non-technical" capabilities are needed. Selecting an occupation or career, developing necessary skills, finding appropriate employment, reaching satisfactory work adjustment, and continually operating responsibly to satisfy one's needs in the work world is a complex, never-ending process which is not well understood or handled effectively by many people. Nor are the systems which intend to assist people in this process very effective.

Finally, the diffusion process was selected as an area of problems to be examined. This area obviously is important to a Center which aims to bring about actual improvements in vocational education, especially in view of the very long time lag which persists in education between invention and widespread use, and in view of the now increasing volume of innovations. The Center shares in the general need for principles, techniques, and tools whereby successful change strategies can be prescribed, given the kinds of innovation, user needs, and system characteristics involved.

We felt constrained in all of these problem areas to single out the occupationally disadvantaged for deliberate attention because there is a persistent and

growing number of students with whom many current programs of all kinds are unsuccessful. The improvement of vocational and technical education for all persons facing serious difficulty in completing training or in securing, retraining or advancing in employment because of individual handicaps or of work-world realities was considered imperative. Perhaps, current programs assume out-of-school conditions, motivations, values, learning, and styles which are not characteristic of many students. But, whatever the reason, these students evidence our failures and present us with an opportunity to identify and correct program deficiencies so that vocational education can make an effective contribution to the development of all students.

Having identified these problem areas for concentrated study, we needed some mechanism by which to mount a sustained, increasingly expert attack on all five areas at once. Our choice was to set up a task force for each problem area.

The Task Force

Our task forces were set up as technical units, primarily, with the intention that each be the principal focus of scholarship, technical competence, and technical planning responsibility in its problem area. Members of each task force were the senior staff members whose competence, current work, and interests were most appropriate to the needs of the task force. Each staff member also was assigned to a second task force, compatible with his capabilities and interests, so that the total pattern of memberships provided communciation channels between task forces as they identified problems, objectives and projects. Research associates, who are doctoral students working at The Center with senior staff, also were invited to participate in various ways. A chairman was designated for each task force with the usual responsibilities of the chairman of a working committee. He was expected to provide leadership for the task force, monitor its progress, and represent it in its communications. Task forces were free to adopt whatever methods and techniques they considered effective in satisfying their objectives. One of The Center's coordinators was assigned to assist each task force as a general consultant, management contact, and monitor. The coordinator was not a member of the task force, but he attended its meetings and participated in its other activities as appropriate to facilitate his helping and coordinating responsibilities. He assisted the task force to identify and interpret its responsibilities, to maintain consistency with Center strategy and procedures, and to coordinate its efforts with those of other task forces. He also was the channel through which all administrative and management assistance and approvals for the task force were directed. General management of task force operations was provided through monthly task force meetings and minutes, quarterly summaries of task force progress, status and plans, and quarterly progress meetings for all chairmen, coordinators and The Center director.

Program Area Document

The first responsibility of each task force was the development of a master

plan to guide the selection, design, coordination, and evaluation of all particular activities (research, development, training, dissemination) in its problem area. The program area document is the written account of that plan.

The document for each area includes the following:

1) A definition of the area which carefully established its boundaries, especially those boundaries shared with other task forces. Since most of the five problem areas where very large to start with, the task forces had many difficult decisions to make in delimiting their areas. Although this is the first section in the document, it usually was prepared, or revised, last.

2) An explanation of the significance of the problem area as defined. It was important in this section to establish the area as related to real and persistent kinds of operational needs.

3) A review and assessment of the status of knowledge and practice in the problem area, including identification of major unresolved problems. This section calls for the best scholarship and judgment we can muster. It is not intended to be just an inventory of the literature; rather, it attempts to give an organized account of the state of affairs and to provide a rational basis for our selection of problems for attention.

4) A strategy for The Center in attacking the problem area. That is, the problems to which The Center should direct its effort are identified in priority order; specific objectives, stated as outcomes to be achieved, are organized into a sequence for each priority problem; and the reasons for these choices are explained. The choices made by the task forces were determined by criteria of several kinds. For example, the conceptual framework used to analyze and assess the area provided some logical distinctions among problems as to priority. The importance to education of a solution or reduction of the problem, as indicated by its pervasiveness, its persistence over time, the extent to which it is recognized widely, and the number of other problems to which it is related, also influenced its priority. Problems and objectives were preferred for which The Center's resources were uniquely appropriate, for which an attack could be devised to build on previous work or to make a crucial contribution to current work, and on which substantial leverage could be obtained.

Each program area document or plan initially represented a substantiated recommendation of the task force primarily based on consideration of its problem area. To arrive at a set of plans which would be a coherent, efficient program of work for The Center, all five plans were subjected to review and discussion by the full staff. This review sought out problems and objectives common to more than one task force plan. It looked for objectives which did, or could be adjusted to, contribute to plans in other areas and examined timing relations among plans to identify efficient and necessary sequences among objectives. These considerations led to some revisions in program area documents, especially in the statements of objectives and the priority rankings of problems.

The documents and revisions also were reviewed by our National Advisory Committee which gave particular attention to the documents' responsiveness to real, durable needs.

The revised set of documents then stood as the technical plan for The Center. It defined the problem areas to which we expected to direct attention, identified in priority order the particular problems we believed we could and should reduce, defined for each problem the specific objectives (outcomes) we intended to achieve and organized them sequentially, and provided a rationale for the effort.

Such plans as these are the essence of programmatic work. They define our destination and our strategy for getting there. They are unlikely to change in major ways or very often. However, they do not specify all the particular projects and activities to be undertaken to achieve the objectives. These are tactical maneuvers chosen to implement the strategy of the plan. Such tactics may have to be adjusted or changed in response to such operating circumstances as unexpected results, different resource levels and the work of others. But the objectives remain relatively unchanged and we keep working in specific ways to achieve them.

Our task forces maintain surveillance of developments related to their problem areas. They continue to reassess the status of knowledge and practice striving to formulate more effective conceptual structures and principles for explaining the phenomena with which they deal. They reconsider priorities and specific objectives as new knowledge, new methods, new efforts, and new needs are identified. So, the program area documents always remain under review by the task force and the whole set is subjected to periodic review by the full staff.

Project Development

A second major responsibility of the task force is to devise specific projects for achieving its objectives. These projects first are described in a précis or brief summary which identifies the problem and task force objectives to which it is addressed, outlines the rationale for the project, states its specific objectives, outlines the methodology to be used, and estimates the duration of the project and the resources required. A priority rating is assigned to each précis by the task force to indicate the relative importance of the project for achievement of task force objectives. Précis from all task forces also are rated by the full staff in accordance with such Center-wide considerations as the probable contribution to objectives in other task force areas, the impact expected on knowledge or practice, the proportion of Center resources required and the effect of this resource allocation on the distribution of resources among problem areas, and the extent to which it is an effective application of the unique capabilities of The Center. All précis then are entered into a pool from which projects are selected for further development at any time funds and personnel are available. Précis may be modified or added to the pool or withdrawn at any time by the task force.

Detailed plans for a project are developed only when it has been selected from the pool. At the time of its selection, the responsible coordinator, in consultation with the task force chairman and the précis author, designates a consultant to work with the author in developing the plan, selects outside reviewers for the completed plan, and sets the necessary deadlines. From this point, development of an effective project plan, including schedules and budgets, is the responsibility of the task force which uses consultants, outside reviewers, staff reviews, and any other appropriate means to produce a plan meeting its needs and the standard Center requirements. When the task force is satisfied with the plan, the chairman certifies it to the coordinator who provides a final review. When this review is satisfied, the project is presented to the director for approval and initiation according to the plan.

CONCLUDING STATEMENT

This paper has been an attempt to sketch our way of doing programmatic work in vocational-technical education. It is far from a complete description of our procedures or our programs. What I have described is a part of an evolving system for evaluation and management of The Center.

Our efforts in programmatic work have encouraged us to continue, but there are some cautions I would identify for those who contemplate such efforts.

1) Program development and execution requires non-trivial amounts of time, talent and sustained support. All of these commodities always are in short supply and can be assembled and maintained only with considerable and skillful effort.

2) Many pressures to divert from your purpose must be accommodated while you doggedly persist on your program. Especially, you can expect many people to ask for results affecting their problem before you are ready, often before you have defined your program or decided to work on their problems. Other people always seem impatient and lacking in understanding of your work.

3) In fact, you may have to compromise to survive. You may have to satisfy some pressing, short-range needs of important groups, whether or not these are part of your program plan, to get the opportunity to develop and work on your program.

4) Finally, it takes courage in substantial amounts to plot a course and persist on it even when, as is inevitable, your program does not include some popular problem or current fad for which funds become available. It can get lonely out there.

VII

THE WORK ADJUSTMENT PROJECT

René V. Dawis[10]

The Work Adjustment Project, also known as the Minnesota Studies in Vocational Rehabilitation, is a continuing programmatic series of research studies being conducted on the general problem of adjustment to work. Specifically, the project focuses on the work adjustment problems relevant to vocational rehabilitation services. The project has been supported since 1957 by consecutive grants from the Office of Vocational Rehabilitation, Vocational Rehabilitation Administration, and now the Rehabilitation Services Administration. It was initiated under the leadership of Professor Lloyd H. Lofquist, who continues today as a principal investigator of the project.

The history of the Work Adjustment Project illustrates a circular model of research and development, involving the interaction and interplay between theory, methodology, and data. Each of these three have developmental implications for the other two. Thus, theory may determine the appropriate methodology as well as the relevant data; methodology certainly determines in large part the nature of the data, but it may also "feedback" to theory and dictate changes therein; and data help assay the adequacy of both theory and methodology. The three components (theory, methodology, and data) exist as some kind of "circular triad" that conceivably can be entered at any point (any of the three components) and if the research scientist persists long enough he is bound to get caught up in the interaction and interplay of the triad.

The history of the Work Adjustment Project also illustrates a linear (as opposed to the preceding circular) model of research and development activities. According to this model, research progresses through three stages: an exploratory stage, in which the researcher attempts to stake out his field, identify some guideposts and in general feel his way around; a descriptive stage, in which the researcher systematically goes over his ground, culminating in a "map" (theory) purporting to represent his area of endeavor; and finally, a testing stage, in which the "map" is tested systematically for adequacy. (This stage may be extended to several substages in which the "map" is revised and retested etc., until a better

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map comes along, or until the mapmaker perishes from old age or, more likely, boredom.) In this (linear model) context, the Work Adjustment Project was in its exploratory stage in 1957-1959, its descriptive stage in 1959-1964 (in 1964 the *Theory of Work Adjustment* was published), its first testing stage in 1964-1968 (a revision of the *Theory of Work Adjustment* was published in 1968), and is now in its second testing stage.

Two major goals provided the focus for the initial research project in 1957: (1) to determine the extent and magnitude of employment problems of the disabled, and (2) to study the effectiveness of job placement procedures currently used in the various rehabilitation services. A two-year grant was received from the then Office of Vocational Rehabilitation in support of the project.

Research plans called for the use of survey methods in identifying the disabled in the general population and in determining their employment problems. Studies were designed to compare the effectiveness of different survey techniques and instruments in achieving these research objectives.

Plans were also outlined to compare a group of individuals receiving special placement services with a control group receiving the typical rehabilitation assistance. Evaluation was to be based on a comparison of outcomes, measured six months after case closure.

To determine the outcomes appropriate as evaluative criteria, a survey of the rehabilitation literature was undertaken. The results of the survey were dismaying. The review of the literature clearly indicated that progress in vocational rehabilitation research would be limited, at best, without meaningful and measurable criteria for the evaluation of vocational rehabilitation outcomes. Research in the first two years laid the groundwork for the study of vocational rehabilitation outcomes. Survey studies provided factual data on the characteristics and problems of the disabled. Methodological investigations helped to indicate realistic directions and limits for later research plans. While specific in scope and, therefore, with only limited implications for vocational rehabilitation practice, these early research efforts contributed to a data pool and to a theoretical point of view that developed as the research progressed.

In 1959 the then Office of Vocational Rehabilitation awarded a five-year grant to the investigators in support of research to develop criterion measures for, and a methodology for the evaluation of, vocational rehabilitation outcomes. One of the first projects undertaken was a survey of the pertinent research literature in psychology, sociology, and industrial relations, as well as in rehabilitation.

After thorough review and evaluation of the research literature, the concept of "work adjustment" was developed to designate the general area encompassing evaluative criteria. The appropriateness of the concept of work adjustment to the evaluation of vocational rehabilitation outcomes was strongly

suggested by research findings from a variety of sources, such as job satisfaction studies, employee attitude studies, studies of industrial conflicts and industry morale, studies utilizing counseling interviews and exit interviews, studies of productivity and efficiency, job tenure studies, and studies of work history patterns.

The investigators' concept of work adjustment was first formally described in 1960 in the monograph, *A Definition of Work Adjustment.* Following the suggestion of Professor Alec Rodger of the University of London, the variables of satisfaction and satisfactoriness were selected as the indicators of work adjustment. "Satisfaction" was defined as work adjustment viewed from the vantage point of the individual, while "satisfactoriness" designated work adjustment viewed from the employer's standpoint.

Satisfaction, according to the 1960 monograph, included overall job satisfaction, and satisfaction with various specific aspects of the individual's work environment, such as his supervisor, his co-workers, his working conditions, hours of work, pay, and type of work. It included the satisfaction of his needs and the fulfillment of his aspirations and expectations, and the similarity of his interests to those of successful persons working in his chosen occupation.

Satisfactoriness, as the other index of work adjustment, included such components as the worker's productivity and efficiency, the congruence of his abilities with job requirements, his ability to get along with his supervisor and his co-workers, and to follow company policies.

Work adjustment was described as a process that occurred throughout the individual's working years. Cycles of satisfaction and dissatisfaction, and of satisfactoriness and unsatisfactoriness, might occur in the individual's work history. Work adjustment patterns might vary for individuals in different occupations, and were likely to be affected by such factors as age, sex, education, training, disability, and adjustment outside the work setting. The study of the interrelationships among work adjustment variables was essential.

The definition of work adjustment in the 1960 monograph provided a useful framework for the Work Adjustment Project. Studies were carried out to develop measures of the work adjustment variables and to enlarge the understanding of work adjustment, especially as it related to the disabled. Research was undertaken to obtain and validate work histories of employees, to measure attitudes of employers, and to develop criterion measures of satisfaction and satisfactoriness.

Increasingly, the explanation and prediction of work adjustment became the major concern of the project. Although the definition of work adjustment had included some useful principles, a more elaborate and integrated theoretical statement concerning work adjustment was needed. As a result, a theory of work adjustment was developed and was published in January, 1964.

Work adjustment is defined in the *Theory of Work Adjustment* as the process by which the individual interacts and comes to terms with his work environment. The outcome of the process is measured by two indicators: satisfactoriness and satisfaction. The significant aspect of the individual in this process is his work personality, that is, his sets of abilities and needs. The significant aspects of the work environment include the abilities required for successful performance of the job and the reinforcers available to the individual. Work adjustment is determined both by the correspondence between abilities and ability requirements, and by the correspondence between reinforcer system and needs.

The *Theory of Work Adjustment* is stated in the following nine propositions.

Proposition I. An individual's work adjustment at any point in time is defined by his concurrent levels of satisfactoriness and satisfaction.

Propositon II. Satisfactoriness is a function of the correspondence between an individual's set of abilities and the ability requirements of the work environment, provided that the individual's needs correspond to the reinforcer system of the work environment.

Proposition III. Satisfaction is a function of the correspondence between the reinforcer system of the work environment and the individual's set of needs, provided that the individual's abilities correspond to the ability requirements of the work environment.

Proposition IV. Satisfaction moderates the functional relationship between satisfactoriness and the correspondence of the individual's ability set to the ability requirements of the work environment.

Proposition V. Satisfactoriness moderates the functional relationship between satisfaction and the correspondence of the reinforcer system of the work environment to the individual's set of needs.

Proposition VI. The probability of an individual's being forced out of the work environment is inversely related to his measured satisfactoriness.

Proposition VII. The probability of an individual's voluntarily leaving the work environment is inversely related to his measured satisfaction.

Proposition VIII. Tenure is a function of satisfactoriness and satisfaction.

Proposition IX. The correspondence between the individual (abilities and needs) and the work environment (ability requirements and reinforcer system) increases as a function of tenure.

A formal test of the *Theory of Work Adjustment* required the translation of its concepts into operational terms. The main concept, "correspondence," required that both the individual and the environment be described using the same or comparable sets of measurement dimensions. These dimensions, according to the the theory, were of two kinds: abilities and needs. The theory also

required the measurement of two intervening variables: satisfactoriness and satisfaction. These variables "intervene" between individual-environment correspondence on the one hand, and tenure-outcome (stay-leave) on the other. Several Work Adjustment Project studies were directed toward the measurement of these variables (abilities, needs, satisfactoriness, and satisfaction). Based on the measurement of abilities and needs, ability-requirement and reinforcer-pattern descriptions of occupations were developed, thereby enabling the measurement of work-personality–work-environment correspondence. This development permitted the first formal tests of the nine propositions. The following research findings lent support to the theory:

1) Measures of satisfactoriness and measures of satisfaction were found to be relatively independent, the overlap in variance being no greater than 10 percent.

2) Satisfactoriness has been predicted from ability-requirement correspondence with correlations of .50 or better.

3) Likewise, satisfaction has been predicted from need-reinforcer correspondence with correlations in the .50's.

4) The prediction of satisfactoriness from ability test scores was found to be more accurate for groups of individuals with high satisfaction scores than for groups of individuals with low satisfaction scores.

5) Tenure has been found to be predictable from satisfaction and satisfactoriness scores.

While these findings were encouraging, the data did point up some methodological problems. (At this point the circular model took over from the linear one.) Prominent among these was the problem of operationalizing "correspondence." One Ph.D dissertation addressed itself in part to this question, with mixed results. It still remains problemmatical. Another problem has been adequacy of sampling the range of abilities and needs. Current instruments are satisfactory, but could be improved. Current levels of prediction (of satisfactoriness and satisfaction) are adequate, but could be improved.

At the present time, the Work Adjustment Project can take one or more of several alternative paths. First though not necessarily most important among these is the improvement of its instruments. Another choice, which bids strongly for top priority, is a research direction indicated by Proposition IX of the theory which states that work-personality -- work-environment correspondence increases as a function of tenure. This proposition implies that such increases in correspondence can occur through changes in the individual, in the environment, or in both individual and environment. Changes in the individual, in turn, imply the modes of work adjustment: an individual may act on his work environment to make it more correspondent to his work personality or he may react to the work environment by changing the manner in which his work personality is expressed, that is, he may accommodate to the work environment and thereby

increase his correspondence with it. The first mode of work adjustment might be called an active mode, and the second a reactive mode. Pursuance of this research direction would move the Work Adjustment Project beyond the study of work adjustment outcomes and the prediction of such outcomes, and into the study of the process of work adjustment.

Other alternative future paths for the Work Adjustment Project include: an intensive study of the concept and measurements of "correspondence"; the longitudinal study (study over time) of the prediction of work adjustment; and the study of counseling applications of the *Theory of Work Adjustment.* The concept of "correspondence" has several parallels in psychometrics (e.g., difference scores, gain scores) and in psychological theory (e.g., balance theory, consistency theory) that makes its study challenging as well as highly important, theoretically speaking. Longitudinal studies have been known to contradict, or have different results from, cross-sectional studies; hence, a rigorous test of the *Theory of Work Adjustment* must include studies that are conducted over time, i.e., follow-up studies. Counseling applications of the theory can best be tried out and developed in a real-life counseling setting, as for instance, in a vocational assessment clinic wherein individuals are given ability tests and complete need questionnaires, and these measurements are interpreted to them in a counseling context.

Finally, mention might be made of "ultimate" paths for the Work Adjustment Project. These would take the form of rigorously controlled experiments on work adjustment such as, as examples: the study of the interaction between specific abilities and specific tasks, singly or in combination; the study of the interaction between specific needs and specific reinforcers, again singly or in combination; the study of cross-interactions (abilities and reinforcers, needs and tasks), etc. Such studies are "ultimate" only in the sense that research scientists always point toward the controlled experiment as the most reliable method of acquiring knowledge.

The preceding has been a brief description of the Work Adjustment Project's past, present, and future. The Project's progress has been described as linear, advancing along a path from exploratory to descriptive to experimental. The project's progress has also been described as circular, the product of the interaction and interplay of theory, methodology, and date. However described, the ongoing Work Adjustment Project only approximates these models, or, more accurately and appropriately, these models only approximate the Work Adjustment Project.

VIII

SUMMARY AND CONCLUSIONS

Frank C. Pratzner[11]
Jerry P. Walker[12]

This final section of the report has been included to provide the opportunity for the editors to comment on the ideas presented in the papers. The "Summary" provides an overview and abstract of the important points made by each of the authors. The "Conclusions" is a discussion of the important commonalities among the papers. These are presented in the form of verifiable propositions about the "intended ends" and "intended means" of programmatic research and development. The set of propositions can be used as the basis for further systematic explication of the two questions posed at the outset of the report: what is programmatic research and development, and, how does one go about doing it.

SUMMARY

The Stufflebeam Paper

Stufflebeam defined and explained programmatic change as a function of two types of processes. The first, general leadership activities, was discussed in terms of decision-making and evaluation. The other type included the specific change strategies of adoption, development, diffusion and research. These two processes were then incorporated into a model for programmatic change. The model provides a conceptual framework for classifying and understanding the types of decisions which precipitate the specific change strategies. The type of programmatic change to be undertaken is directly related to the conditions surrounding the change-precipitating decisions. These conditions include the extent of the decision-makers' information grasp, the degree of change to be affected, and whether the type of decision is one of planning, structuring, implementing or recycling.

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The Gideonse Paper

Gideonse pointed out that the definition of programmatic research and development is not an empirical task so much as it is a policy problem. It is a case of deciding what is required or desired and establishing the procedures and criteria which would best help to create the type of research and development we are trying to call into existence.

It was suggested that programmatic research and development can be usefully defined in terms of the objectives or goals toward which it is aimed. A beginning attempt was made to define and describe three alternative kinds of objectives, and to develop the different criteria and requirements which characterize each. An end state objective of programmatic research and development is one which is identified in terms of trying to achieve something out there for clients: producing the actual change or condition that is identified in the description of the desired end state. A product objective is one which is defined in terms of the creation of a product, process, or technique which when used in a specified fashion yields specified outcomes in a client population or practitioner system. An area objective for programmatic research and development is to create knowledge and test development strategies, on the basis of which "products " or "end state" objectives can ultimately be conceived, decided upon, and achieved.

The analysis of these three objectives suggested a number of management considerations, the scale of effort is a key determinant in the identification of management requirements associated with various kinds of programmatic research and development. It also makes a good deal of difference whether what is to be accomplished is known or determined in advance. In the case of "end state" and "product" objectives, management strategies are essentially convergent but for "area" objectives the results are not known in advance, are essentially divergent in character, and oriented to the cultivation of serendipity.

The character of the three objectives also requires different approaches to the identification, availability, and development of manpower, leads to different information flow requirements within the research and development effort, and suggests significantly different relationships between the research and development community and the larger political and institutional environment.

The Carrese Paper

The difficulties encountered in attempts to apply directly some of the standard network analysis techniques to the planning of research programs were discussed by Carrese. The particularized requirements for a planning system suitable for research efforts were identified, and a technique developed specifically for the planning and programming of research efforts was described. Basically, the technique involves the formulation of a series of flows and arrays depicting major program elements and individual projects, sequentially ordered on the basis of research logic, and graphically represented by a matrix which relates research performance to resources required (including personnel, materials, equipment and facilities, and funds). Because of the nature of

research, the technique was developed to avoid the formulation of tight networks with sharp time-to-completion estimates for each project. If the research logic used for the construction of the matrix represents a valid model of the scientific content of the program to be conducted, and if the sequential ordering of the program elements is accomplished on the basis of this logic, then in reality, as research performance moves in the matrix from left to right in time, the intermediate objectives of each step and phase will be achieved and the scientific scope of the program will become narrower until all efforts converge on the end point which has been established as the overall program goal. Each step, phase, and array has objectives, but the achievement of these objectives is not necessarily dependent on the accomplishment of all the individual research projects within a given phase or its steps, in a given order. Rather, convergence is realized through the net result of the "research package" represented by a step, phase, or array. Tight sequential dependence is avoided wherever possible in the formulation of the arrays.

A planning team which formulates the convergence logic system should not exceed five members whenever practicable and its composition should provide a balance between generalists and specialists. The application of the convergence technique to two biomedical research programs of the National Cancer Institute was discussed. Experience with these programs has shown that sound formulation of program plans cannot be done very effectively on an intermittant basis. A block of time should be set aside for uninterrupted, intensive effort devoted to hammering out the plan. Membership on the team should, therefore, remain unchanged throughout the planning period.

The Hemphill Paper

According to Hemphill, development in education is achieving identity of its own. It is emerging as a new professional activity in education with a definite discipline of its own. The new activity cannot be regarded or evaluated as a new form of applied research since it is basically different in its orientation and in the contribution which it promises to make to the improvement of educational practice.

Educational development provides a powerful way of changing educational practice. It offers a systematic means of creating new educational products and/or new human capabilities which can produce significant changes. Educational development is the process by which a desired change in educational practice is systematically and deliberately brought about.

Two major approaches to educational development were identified. Product development creates materials, procedures, or devices which, when used as directed, promise to yield desirable and specified outcomes. Educational development following the change support approach emphasizes intervention in the behavior of education. Most of the strategies employed today appear to be mixed ones involving different degrees of use of one or the other of these two basic approaches.

The Far West Laboratory's model for development was described in 10 parts: (1) conceptualization and planning, (2) preliminary product design, (3) preliminary field testing, (4) preliminary product revision, (5) main field testing, (6) main product revision, (7) operational product testing, (8) operational product revision, (9) dissemination planning, and (10) product dissemination.

Good research work may be managed on a project basis but effective development work requires program management. The basic difference between program management and project management is the commitment that is made at the outset to the attainment of objectives in the case of program management and to the execution of a set of predetermined plans in the case of project management.

The Moss Paper

Moss' primary intent was to advocate a rationale and a procedure for determining how educational research-related funds should be spent. The ultimate reason for all research-related activities in vocational education is to improve the quality of practice in the field. Education is being required to change so rapidly in light of new social values and goals, that it is encountering problems that cannot even be defined sensibly: we frequently do not know what we need to know.

A major effort is required to identify our critical research-related goals, plan how to attain them, and using the plans, embark upon systematic, coordinated research-related activities to obtain solutions to important and complex problems. We have experienced too much of the alternative: unrelated, episodic activities dependent upon the unique interests of investigators.

Among the conditions proposed for managed research and development were: (1) limiting spending to the attainment of a relatively few realistic goals and directed to attract and support the type of research needed at a given point-in-time, (2) a supply of adaptable researchers able to accept general directions for their work, (3) close coordination among the federal offices administering funds and voluntary coordination among the states in planning activities, (4) a reasonable funding level provided at a predictable rate, and (5) availability of an acceptable procedure for establishing goals and planning for their attainment.

Moss provided the outline for one possible procedure, at the national level, to systematically identify and select crucial national goals for research-related efforts in vocational education, and to allocate the commissioner's resources to the conduct of programmatic activities designed to attain the goals. The steps in the procedure which were proposed and discussed included: (1) developing a theoretical model of the vocational education system, (2) identifying and selecting long-range goals for research and development, (3) planning research and development activities, and (4) allocating resources to research-related activities.

The Morrison Paper

Morrison described the development of the programmatic work of The Center, the major kinds of decisions which were necessary, and the principal mechanisms which have been evolved to operate and manage the effort. The objectives and functions of The Center were described as: (1) providing continuing reappraisal of the role and function of vocational-technical education, (2) stimulating and strengthening state, regional, and national programs of applied research and development toward the solution of pressing problems, (3) encouraging the development of research to improve vocational-technical education in institutions of higher education and other appropriate settings, (4) conducting research studies toward development of new knowledge and new applications of existing knowledge, (5) upgrading vocational leadership through advanced study and in-service programs, and (6) providing a national information storage, retrieval, and dissemination system for vocational-technical education.

Five program areas were identified and judged most promising for application of the amounts and kinds of talent and resources available to The Center: Management Systems, Personnel Development, Instructional Systems Design, Vocational Development and Adjustment, and Diffusion Process. The Center intends to evolve effective transformations in vocational education systems, to adapt methods, points of attack and timing for maximum leverage on each selected problem area, and to take into full account the work of others.

A task force was set up for each problem area. Task forces serve as technical units and each is the principal focus of scholarship, technical competence, and technical planning responsibility in the problem area. Each task force develops and periodically revises a program area document which serves as a master plan to guide the selection, design, coordination, and evaluation of all activities in its problem area. The documents define the sub-problems within each of the broader problem areas which will receive direct attention, identify in priority order the particular problems which could and should be reduced, define for each problem the specific objectives (outcomes) to be achieved and organize them sequentially, and provide a rationale for the effort.

Task forces are subsequently responsible for devising specific projects for achieving their objectives. An effective project plan includes schedules and budgets and is developed using consultants, outside reviewers, staff reviews, and any other appropriate means to produce a plan meeting its needs and Center requirements.

The Dawis Paper

Dawis described the continuing programmatic series of research studies on the general problem of adjustment to work. The project was characterized by a "circular" model of research and development and illustrates an overall "linear" progression through three stages of activity.

The circular model of research and development on work adjustment involves the interaction and interplay of three components: theory, methodology, and data. Some of the developmental implications which resulted from activity on each of the components were illustrated by reference to the Work Adjustment Project.

The Work Adjustment Project was further described as having moved linearly through three stages of development: an exploratory stage where guidelines for research and development are established and the boundaries of the problem area are described; a descriptive state where the problem area is further delineated to produce a "map" (theory) to represent and guide action; and finally a testing stage, consisting of several substages, in which the model or map is refined and improved through test, revision and re-test sequences.

Several alternative directions for future research and development were identified and briefly discussed.

CONCLUSIONS

In this section, the editors have attempted to draw conclusions and implications from the seven papers. They have done so by offering propositions in response to three fundamental questions about programmatic research and development: (1) Why do we have programmatic research and development? (2) What are the ends of programmatic research and development?(3) What are some "propositions" for conducting programmatic research and development?

It should be clear that the questions, and the propositions offered in response to them are, inevitably, derived from the selective perceptions and experiences of the editors. They are not offered as exhaustive nor necessarily discrete. But it can be argued that they are necessary propositions for the planning and conduct of programmatic research and development; no claims are made that they are a sufficient set of propositions for understanding and conducting programmatic research and development.

It is hoped that they are provocative, that the reader will carefully review them and search for their origins in the report itself, and that he will test their validity against past and future experiences and observations.

Why do we have programmatic research and development in education? The foremost rationale for federally supported programmatic research and development is its contribution and potential for the improvement and not the maintenance of the American educational system. In the United States, nearly 20,000, relatively autonomous, independent school districts maintain the educational system. It is not now, nor has it been, the function of the federal government to provide services for the maintenance of the nation's educational system. Educational improvement as the *raison d'etre* of programmatic research and development is a key point stressed in introductory sections by both Moss and Hemphill. Improvement, by definition, implies a positive change in a state of

affairs – a point stated or implied in all of the papers. Change is always precipitated by some type of anomaly. An anomaly is a discrepancy in the environment between expectations and observations: ought vs. is; intended vs. actual; desired vs. observed. Thus, all of the activities of programmatic research and development are attempts to reduce or eliminate discrepancies between expectations and observations.

Clearly, programmatic research and development is not a means for providing direct services for the nation's students. At first glance, this proposition may seem contradictory to the preceding notions about improvement, change, and expectations. But it should be noted that several authors emphasize the principal of leverage as a characteristic of programmatic research and development. Morrison, for example, maintains that The Center for Vocational and Technical Education must be a "wholesaler," not a "retailer" of educational services. Hemphill's lengthy and cogent discussion of the several steps of field testing, characteristic of educational development, are not means for providing direct services to students. Rather, they are means for obtaining feedback on the efficacy of products under development – products which must be generalizable, replicable, and capable of use in settings other than those in which they were developed. In addition, practicality mitigates against federally-supported research and development providing services to students. Currently, approximately one-third of one percent of the total expenditures for education in the U.S. is allocated for all research and development; this miniscule amount demands that programmatic research and development seek and operationalize criteria of leverage, wholesaling, generalizability, and replicability.

A final reason for the existence of programmatic research and development is that scarce resources must be effectively allocated to reduce important and persistent educational problems. Thus, the identification of desirable outcomes (objectives, ends, goals, purposes, etc.) is the single most critical and difficult task facing programmatic research and development. This point is clearly supported by Moss' discussion of "politically popular" goals; Stufflebeam's emphasis on context evaluation; Morrison's rationale for Program Area Documents; Hemphill's argument for clear and consistent objectives; and the very premise of Gideonse's paper which argues that the characteristics and conduct of programmatic research and development are determined by the types of objectives it seeks to attain. The difficulties and importance of identifying and stating outcomes is compounded by the necessity that they simultaneously meet a variety of political, substantive, and feasibility-type criteria. Recall also Moss' assertion that the intended ends for programmatic research and development are policy decisions which should be made by non-substantive experts (e.g., program administrators) while the means for their attainment should be the decisions of the substantive experts (e.g., research and development specialists).

Thus, the following points were made in response to the question -- Why programmatic research and development:

1) Its purpose is educational improvement, not maintenance.

2) It always seeks a change in the state of educational affairs.

3) It is always precipitated by an anomaly between an expectation and an observation.

4) Its conduct and activities are always means for attempting to reduce a discrepancy between expectations and observations.

5) It is not a means of providing direct services to students

6) It is a rational means for effectively allocating scarce resources toward the reduction of important and persistent educational problems.

What are the ends of programmatic research and development? If the "why" question has been answered, it is now appropriate to respond to the question of the different types of outcomes sought by programmatic research and development. Gideonse provides us with an excellent classification scheme for determining the types of ends which might be sought through programmatic research and development. His discussion of end state, product, and area objectives appears to exhaust the types of intended ends for programmatic research and development. It is interesting to note that the organizations represented by the other authors fall under each type of objectives. For example, the National Cancer Institute appears to pursue end state objectives (i.e., the elimination of leukemia). The "change support" objectives of the Far West Laboratory are of the end state variety in that they attempt to alter the behavior of educational clients. The product development objectives of the Far West Laboratory are clear examples of Gideonse's product objectives category. Both The Center for Vocational and Technical Education and the Work Adjustment Project appear to pursue area objectives.

The importance of discussing the types of objectives for programmatic research and development is embodied in the fact that the very nature and conduct of programmatic research and development differs as a function of the type of objective it pursues.

In response to the question, "What ends should programmatic research and development pursue?", it is difficult to extend or improve upon the contribution by Gideonse. His classification of types of objectives seems sound and exhaustive. The importance of ends was emphasized by the proposition that they determine the very nature and conduct of programmatic research and development. This proposition is supported by the ease with which the diverse organizations represented by the authors could be readily classified according to one or many of Gideonse's three types of objectives.

What are some propositions for conducting programmatic research and development? In this section, an attempt was made to support three basic propositions: that programmatic research and development must (1) be congruent, (2) transcend project research and development, and (3) be adaptable and systematic. The propositions and points relative to each have not been supported, in

every case, by reference to their author. However, the following is felt to be a faithful and accurate discussion of their intent.

Programmatic research and development must be congruent. The essence of the congruence proposition is the necessity for consistency among and between ends and means. A fundamental axiom is that ends must precede means. In addition, congruence must be assured among ends. From ends identified at the global, philosophical, and even emotional level down to ends identified at the level of specific operational objectives which guide the day-to-day conduct of research and development activities, congruence must be maintained. The simplicity of the "ends, then means" sequence may be misleading. Examples abound where means have determined ends (e.g., esoteric instruments determining research problems; interests of principal investigators determining, or altering the goals of programs; and many examples of successful, interesting, or popular pursuits becoming ends in themselves). In fact, it is only when means flow from ends that other principles for successful programmatic research and development can be followed. For example, collaborative and cooperative interagency relationships are greatly enhanced when ends are commonly identified and agreed upon.

Congruence among ends from the philosophical to the operational level appears to be absolutely essential to the effective conduct of programmatic research and development. This point cannot be overemphasized. It is supported again and again by several authors. For example, Morrison's discussion of The Center for Vocational and Techical Education's organizational and operational structure illustrates their attempts to maintain congruence among The Center's mission, its program objectives and the outputs of its projects; the Convergence Technique used by the National Cancer Institute epitomizes the need for a single subsuming goal to justify and legitimize all research efforts; the discussion by Moss provides principles and techniques for assuring congruence in the identification and statement of clear and concise ends. While the importance of congruence among ends across agencies is stressed by several authors, the difficulties of obtaining this congruence are evident in the competitive rather than cooperative atmosphere which often characterizes the relationship among similar educational agencies.

Programs transcend projects. The second major "how to" proposition is that programmatic research and development must transcend project research and development. This proposition is probably best represented by Hemphill's assertion that projects can in fact fail; programs cannot. Projects, in effect, are the means toward the attainment of program goals and as such they are subject to adaptation, variability, change, and termination. The programmatic goals toward which the means (i.e., projects) are directed remain inflexible and constant. In other words, research and development programs are long-range sustained efforts toward reducing a discrepancy between observations and expectations. Projects, on the other hand, are smaller, time-defined efforts to attain

specific intermediate and operational objectives. It is therefore conceivable that all of a program's project objectives could be attained while the program goals remain unattained. However, the likelihood of the sum of the project objectives being equivalent to program goals is greatly increased if the principle of congruence has also been met.

Operationally, the proposition that programs must transcend projects is reflected in the necessity for a division of labor among research and development specialists. At least a two-fold division of labor is needed within research and development teams: (1) substantive expertise complimented by (2) planning and administrative competencies. An additional outcome of this propositon is that the composition of research and development teams be characterized by individuals with substantive as well as administrative expertise, adaptability, and an orientation and commitment to the mission of the research and development agency. The necessity for substantive as well as administrative expertise is described by both Morrison and Carrese. Moss stresses the need for adaptability in his assertion that specialists must be able to accept general direction for their work. The need for adaptability and mission orientation among research and development specialists grows out of the necessity for maintaining congruence among ends within an agency, and the necessity for first stating ends, then deriving means.

In short, the discussion of the proposition that programs must transcend projects emphasized the long-range aspect of programs; the legitimacy of projects failing because of their status as means; the need for an effective division of labor among research and development specialist teams; and the manning of those teams with adaptable, mission-oriented individuals of sufficient substantive and administrative expertise. As an aside, there is apparent agreement between Morrison and Carrese about the need for a division of labor and the composition of research and development specialist teams. However, in the setting described by Morrison, principal investigators are under a common roof in the interest of interpersonal, face-to-face communication and collaboration; while in Carrese's setting, investigators are seldom in face-to-face communication and interaction. Thus, an interesting hypothesis emerges: is the "common roof adage," in fact, a principle or necessity for effective programmatic research and development.

Programmatic research and development must be adaptable and systematic. The third proposition is supported by virtually all of the papers; it is simply that, to be effective, programmatic research and development must be both adaptable and systematic. In one way or another the necessity of systematic adaptation to feedback is emphasized by all of the authors. The essence of the Stufflebeam evaluation and decision-making model is one of reacting to periodic feedback, especially during so-called process and product evaluation stages. The Convergence Technique described by Carrese stresses again and again the need for acting upon specified information at key decision points along the linear and

concurrent arrays. Hemphill discusses the intricate interplay of research, evaluation, and development and emphasizes the need for information systems to serve key decisions in the development process; virtually all of the "developmental steps" he describes are characterized by systematic adaptation to feedback provided through the many field tests and revision cycles. The interesting and cogent discussion by Dawis of the interplay among theory, methodology and data also reflects the principle of adaptation. His "triadic circularity," in which data gave rise to theory, theory to methodology, methodology to data, *ad infinitum* during the course of over a decade of programmatic inquiry, epitomizes the principle of systematic adaptation. The built-in monitoring of programs and projects at The Center for Vocational and Technical Education is another operational example of systematic adaptation in the conduct of programmatic research and development.

It should be very clear that adaptivity and systemization are not antithetical. The challenge to research and development practitioners and managers is to maintain an appropriate balance between systemization and adaptivity -- both are necessary for programmatic research and development. "Over adaptivity," in the absence of a systematic framework, leaves one at the whim of prevailing social-political winds; "over systemization," without provisions for adaptation, leads to the dysfunctionality of detailed synoptic planning cautioned against by Hemphill and others.

*U.S.Government Printing Office: 1972 — 756-084